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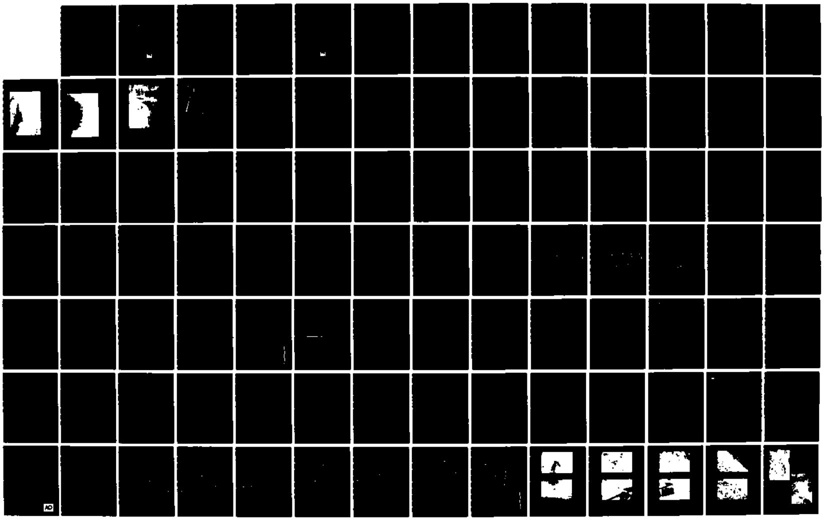

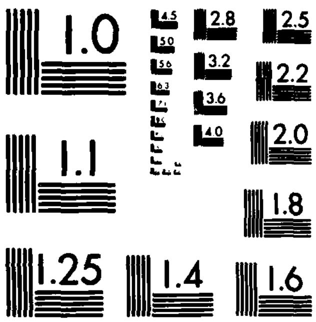

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AD-A144 580

QUINEBAUG RIVER BASIN
UNION, CONNECTICUT

MASHAPAUG POND
SPILLWAY (CT 00640),
DIKE CT 01699,
DAM (CT 01700)

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

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MARCH 1981

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CT 00640 CT 01699 CT 01700	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Mashapaug Pond Spillway CT, Dike CT, Dam CT. NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE March 1981
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18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Quinebaug River Basin
Union, Connecticut

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Mashapaug Pond Dam is an earth embankment dam approximately 290 feet long, 20 feet wide at the crest and 21 feet high at the outlet works. The test flood for this dam, dike and spillway is the PMF. All three structures are classified as INTERMEDIATE in size, with a HIGH hazard potential for the dam and dike and a low hazard potential for the spillway.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION. CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

JUL 16 1981

NEDED

Honorable William A. O'Neill
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor O'Neill:

Inclosed is a copy of the Mashapaug Pond Dam, Dike and Spillway, (CT-01700, CT-01699 and CT-00640) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. This report is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. I approve the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is vitally important.

Copies of this report have been forwarded to the Department of Environmental Protection, and to the owner, American Optical Company, 14 Mechanic Street, Southbridge, MA 01550. Copies will be available to the public in thirty days.

I wish to thank you and the Department of Environmental Protection for your cooperation in this program.

Sincerely,

C. E. Edgar III

C. E. EDGAR, III
Colonel, Corps of Engineers
Commander and Division Engineer

Incl
As stated

QUINEBAUG RIVER BASIN

UNION, CONNECTICUT

MASHAPAUG POND

SPILLWAY CT 00640
DIKE CT 01699
DAM CT 01700

PHASE 1 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

MARCH 1981

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification Nos.:	
Dam:	CT 01700
Dike:	CT 01699
Spillway:	CT 00640
Name of Dam:	Mashapaug Pond Dam
Name of Dike:	Mashapaug Pond Dike
Name of Spillway:	Mashapaug Pond Spillway
Town:	Union
County and State:	Tolland, Connecticut
Streams:	
Inflow:	Wells Brook
Outflow:	Quinebaug River
	Bigelow Brook
Owner:	American Optical Company
Date of Inspection:	2 December 1980

BRIEF ASSESSMENT

Mashapaug Pond Dam is an earth embankment dam approximately 290 feet long, 20 feet wide at the crest and 21 feet high at the outlet works. Both upstream and downstream slopes of the embankment are rather steep, 1¼H:1V. The upstream slope is protected by hand placed riprap. There are two 30" pipes traversing the dam with a gate house structure on the downstream side.

The dike is an earth embankment structure approximately 500 feet long, 15 feet high, and 16 feet wide at the crest. Both upstream and downstream slopes are 1½H:1V. There is intermittent riprap protection on the upstream slope with sections repaired and other sections collapsed.

The spillway is located at the southerly end of the pond. It is a concrete structure 60 feet in length and 10 feet high. Jointly, the three structures make possible the maintenance of the water level in Mashapaug Pond. This pond is a recreational facility which impounds water flowing in from Wells Brook and other minor streams of an irregular watershed. The original facilities were constructed in the eighteenth century and raised to their present elevations in 1900. No construction plans or other data of the original facilities or reconstruction are available.

As a result of the visual inspection and hydraulic and hydrologic computations all three structures are considered to be in POOR condition. To assure the long term performance of these facilities, several items of concern require attention:

The extensive seepage observed downstream of the dam and dike, which represents a potential for piping, erosion and embankment instability.

Extensive tree growth on the dam and dike, which represents the risk of damage due to tree uprooting and seepage along decaying roots.

The erosion at certain areas of the dike crest, the irregularity of the surface, and apparent creep of the downstream slope of the dike, which indicate insufficient stability.

The deterioration of the concrete spillway structure, which can eventually result in its failure.

Due to the inadequacy of the spillway to pass the test flood, a detailed hydrologic-hydraulic investigation should be performed to assess the potential of overtopping the dam and the need and means to increase the project discharge capacity.

All three structures are classified as INTERMEDIATE in size, with a HIGH hazard potential for the dam and dike and a LOW hazard potential for the spillway, in accordance with the recommended guidelines established by the Corps of Engineers.

The test flood for this dam, dike and spillway is the Probable Maximum Flood (PMF). This test flood has an inflow of 7,800 cfs and an outflow discharge equal to 6,100 cfs. This outflow will overtop the dam and dike embankments by 1.5 feet and the spillway abutments by 4.3 feet.

The present combined maximum outflow capacity of the spillway at the southerly end and outlet works at the northerly end is 1,500 cfs at the top of the dam, which represents 25% of the test flood outflow.

It is recommended that the owner retain the services of a registered professional engineer experienced in dam engineering to perform a more detailed analysis of the problems discussed above and in Section 7 of this report. The recommendations and remedial measures should be instituted within one year of the owners receipt of this report.

LENARD & DILAJ ENGINEERING, INC.

By: ______________________

John F. Lenard, P.E.
President

Michael Dilaj, P.E., Vice-President
Project Manager

This Phase I Inspection Report on Mashapaug Pond Dam, Dike, and Spillway has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Joe Finegan

JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division

Aramast Mahtesian

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation. However, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

TABLE OF CONTENTS

APPENDICES

OVERVIEW PHOTO - DAM

15 DECEMBER 1980

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS LENARD-DILAJ ENGINEERING, INC. STORRS, CONNECTICUT ENGINEER	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	MASHAPAUG POND UNION, CONNECTICUT CT 01700 JAN. 1981

OVERVIEW PHOTO - DIKE

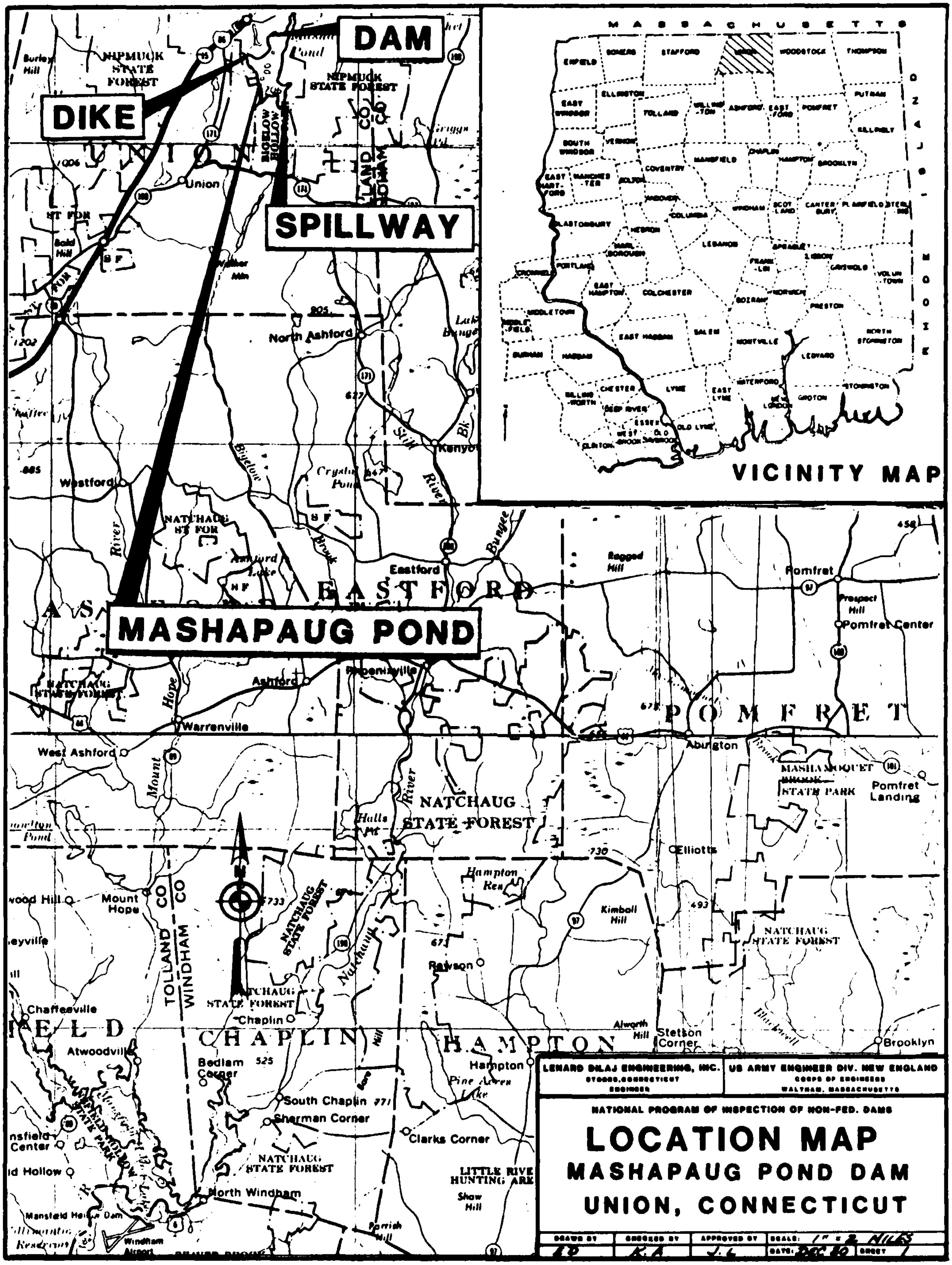
15 DECEMBER 1980

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS LENARD-DILAJ ENGINEERING, INC. STORRS, CONNECTICUT ENGINEER	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	MASHAPAUG POND UNION, CONNECTICUT CT 01699 JAN. 1981

OVERVIEW PHOTO - SPILLWAY

2 DECEMBER 1980

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS LENARD-DILAJ ENGINEERING, INC. STORRS, CONNECTICUT ENGINEER	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	MASHAPAUG POND UNION, CONNECTICUT CT 01699 JAN. 1981


DAM
DIKE
SPILLWAY
MASHAPAUG POND
NIPMUCK STATE FOREST
VICINITY MAP
MASSACHUSETTS
RHODE ISLAND
NATCHAUG STATE FOREST
North Ashford
Westford
Eastford
Ashford
Warrenville
West Ashford
Union
Pomfret
Pomfret Center
Abington
Elliotts
Kimball Hill
Phoenixville
Chaplin
Hampton
Mount Hope
Chaffeeville
Atwoodville
South Chaplin
Sherman Corner
Clarks Corner
North Windham
Bedlam Corner
Stetson Corner
Brooklyn
Pomfret Landing
TOLLAND CO
WINDHAM CO
EASTFORD
POMFRET
CHAPLIN
HAMPTON
LENARD DILAJ ENGINEERING, INC.
US ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
LOCATION MAP
MASHAPAUG POND DAM
UNION, CONNECTICUT
SCALE: 1" = 2 MILES

PHASE I INSPECTION REPORT

SECTION I - PROJECT INFORMATION

1.1 General:

a. Authority: Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Lenard & Dilaj Engineering, Inc. has been retained by the New England Division to inspect and report on selected dams in the States of Connecticut and Rhode Island. Authorization and notice to proceed were issued to Lenard & Dilaj Engineering, Inc. under a letter of 6 November, 1980 from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-81-C-0014 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection Program: The purposes of the program are to:

1. Perform technical inspection and evaluation of non-federal dams to identify conditions requiring correction in a timely manner by non-federal interest.

2. Encourage and prepare the states to quickly initiate effective dam inspection programs for non-federal dams.

3. To update, verify and complete the National Inventory of Dams.

c. Scope of Inspection Program: The scope of this Phase I inspection report includes:

1. Gathering, reviewing and presenting all available data as can be obtained from the owners, previous owners, the state and other associated parties.

2. A field inspection of the facility detailing the visual condition of the dam, embankments and appurtenant structures.

3. Computations concerning the hydraulics and hydrology of the facility and its relationship to the calculated flood through the existing spillway.

4. An assessment of the condition of the facility and corrective measures required.

It should be noted that this report does not pass judgment on the safety or stability of the dam other than on a visual basis. The inspection is to identify those features of the dam which need corrective action and/or further study.

1.2 Description of the Project:

a. Location: The dam, dike and spillway at Mashapaug Pond are located in the Town of Union, County of Tolland, and State of Connecticut. Inflow to the pond is from Wells Brook and outflow from the spillway at the southerly end marks the beginning of Bigelow Brook. Mashapaug Pond is located just south of Interstate Route 86 and the Massachusetts - Connecticut state line, north of State Route 197, and east of State Route 171. The entire project is shown on the Wales, Mass.-Conn. USGS quadrangle map. Coordinates of the structures are as follows:

	North Latitude	West Longitude
Dam	42° 01' 17"	72° 08' 06"
Dike	42° 01' 10"	72° 08' 25"
Spillway	42° 00' 18"	72° 07' 46"

b. Description of Facilities:

1. Dam and Appurtenances: The dam at Mashapaug Pond is located approximately 1,500 feet northeast of the dike and along the northerly section of the pond (see Watershed Map in Appendix D). It is an earth embankment 290 feet long, 20 feet wide at the crest and 21 feet high at the outlet works. The typical slope on the upstream side is 1¼H:1V and is protected by hand placed riprap. The downstream slope is also 1¼H:1V and somewhat steeper at certain locations. The outlet works consists of two 30-inch pipes passing beneath the center of the dam to a stone masonry wetwell on the downstream slope which houses two gate valves. Water is then discharged from this structure through a 5 foot wide by 3 foot high outlet conduit into a pond on the downstream side. The original stone masonry headwall at the outlet conduit on the upstream side was capped with reinforced concrete, as shown on Photo 6.

During the winter months, the pond level is kept 2 feet below spillway elevation in order to protect waterfront facilities. Spillway elevation is marked with a nail in a tree near the discharge conduit. Gate valves are also opened during very high runoff periods. Recreational use dictates the maintenance of the water surface elevation in the pond during other times of the year.

2. Dike: The dike is located on the west side of Mashapaug Pond (see Watershed Map in Appendix D). It is approximately 500 feet long, 15 feet high, and 16 feet wide at the crest. Both the upstream and downstream slopes are approximately 1½H:1V. There is intermittent riprap protection on the upstream slope.

   Water level cannot be controlled at this structure since it has no outlet works.

3. Spillway and Appurtenances: The spillway at Mashapaug Pond is a reinforced concrete structure 10 feet high above the channel bottom, 60 feet long, and 4.5 feet wide at the top of the abutments. The crest section at the center of the structure is 25 feet long and it is 2 feet lower than the abutments. The downstream slope of the reinforced concrete spillway has a slope of 1H:3V. The structure is anchored to bedrock at both abutments. There is also a bedrock outcropping at the base, but the exact foundation conditions are not known.

   Water level is controlled by the spillway crest elevation at this structure. Two conduits located at the dam control the water elevation in the pond during the winter months. At other times of the year and during high runoff periods, water level is maintained at spillway level and discharged into Bigelow Brook.

   The spillway structure is located near the parking lot of the Bigelow Hollow State Park. This park is maintained by the State of Connecticut and has extensive recreational usage.

c. Size Classification: With the pool level at the top of the dam and dike, the impoundment capacity of Mashapaug Pond is 6,725 acre feet. The dam, dike and spillway are respectively 21 feet, 15 feet, and 10 feet high. The impoundment capacity of Mashapaug Pond with the pool level at the top of the spillway abutments is approximately ,5860 acre feet. Based

on the impoundment capacity, all three structures are therefore classified as INTERMEDIATE in size in accordance with the recommended guidelines of the Corps of Engineers (See Appendix D for dam size criteria).

d. Hazard Classification: The dam and dike are classified as having a HIGH hazard potential, because the failure discharge from a breach of either the dam or dike would damage numerous homes, commercial establishments, an interstate highway, and several local highways, and it could potentially cause the loss of more than a few lives. The hazard area for the dam and dike is the same since both would discharge their flows into Lower Mashapaug Pond. Because the dike presented the greater outflow due to a breach, the downstream failure analysis covered only that portion of the facility, although the dam and dike outflows were calculated for comparison purposes. The greatest damage to homes would be around the perimeter of Hamilton Reservoir, which begins about a half mile downstream of the dam and dike and then extends about 3 miles northerly into Massachusetts. Since the prefailure flow of 250 cfs from the outlet works would produce a negligible depth in the reservoir, the post failure depth of 4 to 6 feet would mean that many of the houses could be flooded by as much as 2 to 4 feet. The damage to the interstate highway would be at I-86 which is located 2,700 feet downstream of the dike. The spillway, because of its limited outflow capacity at breach and because of the lack of any significant downstream development, is classified as having a LOW hazard potential.

e. Ownership: The dam, dike and spillway at Mashapaug Pond are owned by the American Optical Company of 14 Mechanic Street, Southbridge, Massachusetts 01550.

f. Operator: The operating personnel are under the direction of the manager of facilities engineering, American Optical Company, 14 Mechanic Street, Southbridge, Massachusetts 01550, telephone (617) 765-9711.

g. Purpose of Structures: The purpose of all three structures is to maintain a recreational pool for Bigelow Hollow State Park, located at the southern end of the pond. Originally, the facilities of Mashapaug Pond served to provide controlled flows to many commercial establishments both at the dam site and further downstream (i.e., north of the dam, where discharge flows into the Quinebaug River Basin). Flows were used to generate mechanical power at these sites.

h. Design and Construction History: Facilities at Mashapaug Pond were originally constructed in 1740 for the generation of mechanical power for downstream mills. In 1899, the dam, dike, and spillway were raised to their present elevations. The spillway was probably built during this reconstruction, since no previous mention in records could be found and it was not shown on older maps. No construction drawings or records are available regarding the history of construction, repair or maintenance.

i. Normal Operating Procedure: Water level in the pond is controlled by the two outlet pipes at the dam and by the spillway at the southern end of the pond. During the winter months, the water level is lowered by approximately 2 feet below the spillway crest in order to protect the waterfront facilities. This lower water level is achieved by opening the gate valves installed on the two 30-inch discharge pipes. When water reaches a certain level marked with a nail in a tree near the outlet works, the gate valves are opened. During the summer, waterlevel is raised to spillway elevation and is controlled automatically by discharge through the spillway.

1.3 Pertinent Data:

a. Drainage Area: Mashapaug Pond and its drainage area are located in Tolland County in northeastern Connecticut (a small portion of the watershed is in Massachusetts). The basin is irregular in shape with an approximate width of one mile, a length of 5 miles, and a total drainage area of 4.68 square miles (see Watershed Map in Appendix D). The longitudinal axis of the drainage area is aligned in a northeast to southwest direction. The topography is characterized by hilly terrain with elevations ranging from a high of 1,290 feet at Stickney Hill at the southwesterly end of the drainage area to a low of 706 feet at the spillway crest. Basin slopes are steep to moderate with grades ranging from 4% to 50%. Buckley Pond, Welles Pond, and a small wetland area at the southerly end of the watershed are the only outside storage areas in the watershed. They are, however, so small that their effect in dampening and delaying the peak of the surface runoff during a high intensity rainfall event is considered negligible. A schematic diagram and associated calculations for the watershed analysis are attached in Appendix D of this report.

b. Discharge at Dam Site: No records of spillway or outlet works discharges are available for this site.

Listed below are calculated discharge data for the spillway and outlet works at the dam.

1.	Outlet works:	
	Size:	2-30" Dia. pipes
	Invert Elev.:	689.7 feet
	Discharge capacity:	200 cfs (at spillway crest elevation)
2.	Maximum known flood at dam site:	August 1955, discharge unknown
3.	Ungated spillway capacity at top of dam (including flow over abutments):	1,260 cfs at Elev.710.8
4.	Ungated spillway capacity at test flood elevation (including flow over abutments):	2,180 cfs at Elev. 712.3
5.	Gated spillway capacity at normal pool elevation:	N/A
6.	Gated spillway capacity at test flood elevation:	N/A
7.	Total spillway capacity at test flood elevation:	2,180 cfs at Elev.712.3
8.	Total project discharge at top of dam:	1,500 cfs at Elev.710.8
9.	Total project discharge at test flood elevation:	6,130 cfs at Elev. 712.3

c. Elevation (Feet above National Geodetic Vertical Datum):

1.	Streambed at toe of dam:	689.7
	Streambed at toe of dike:	695.5
	Streambed at toe of spillway:	698.0
2.	Bottom of cutoff:	Unknown
3.	Maximum tailwater:	Unknown
4.	Normal pool:	706.0
5.	Full flood control pool:	N/A

6. Spillway crest: 706.0

7. Design surcharge (original design): Unknown

8. Top of dam: 710.8
Top of dike: 710.1
Top of spillway abutments: 708.0

9. Test flood surcharge: 712.3

d. Reservoir (Length in Feet):

1. Normal pool: 8,700

2. Flood control pool: N/A

3. Spillway crest pool: 8,700

4. Top of dam: 9,200

5. Test flood pool: 9,500

e. Storage (Acre Feet):

1. Normal pool: 5,300

2. Flood control pool: N/A

3. Spillway crest pool: 5,300

4. Top of Dam: 6,700

5. Test flood pool: 7,200

f. Reservoir Surface (Acres):

1. Normal pool: 273

2. Flood control pool: N/A

3. Spillway crest: 273

4. Test flood pool: 340

5. Top of dam: 326

g. Dam and Dike:

		Dam	Dike
1.	Type:	Earth embankment concrete wall at downstream outlet	Earth embankment
2.	Length:	290 feet	500 feet
3.	Height:	21 feet	15 feet
4.	Top width:	20 feet	16 feet
5.	Side slopes:	1¼H:1V	1½H:1V
6.	Zoning:	Unknown	Unknown
7.	Impervious core:	Unknown	Unknown
8.	Cutoff:	Unknown	Unknown
9.	Grout curtain:	Unknown	Unknown

h. Diversion and Regulating Tunnel: N/A

i. Spillway:

1.	Type:	Concrete, broad crest
2.	Length of weir:	25 feet
3.	Crest elevation (without flashboards):	706.0 feet
4.	Gates:	None
5.	U/S channel:	Reservoir bottom Sand and silt
6.	D/S channel:	Natural streambed Bedrock and cobbles

J. Regulating Outlets:

1.	Invert:	689.7 feet
2.	Size:	2 @ 30" diameter
3.	Description:	Pipe (type unknown)
4.	Control mechanism:	2 gate valves in wetwell
5.	Other:	Pipes have intake 50 feet into pond,pass beneath dam into wetwell,and then discharge through gate valves and rectangular 3'H x 5'W outlet into Lower Mashapaug Pond.

SECTION 2

ENGINEERING DATA

2.1 Design: No data on the design of the dam, dike, or spillway has been recovered and none probably exists.

2.2 Construction: Very little is known about the construction of the dam. The first construction in the vicinity of Mashapaug Pond is said to have taken place in 1740, although exact dates for construction of the dam or dike could not be established. In 1899 the facility was raised by 5 feet to its present elevation. The spillway was probably constructed at that time.

2.3 Operation: No formal records of operation are maintained for this facility. During late fall the water level is lowered in the pond in order to protect waterfront facilities during the winter months. The water level is kept approximately 2 feet below spillway elevation.

2.4 Evaluation of Data:

a. Availability: There are no plans, specifications, or computations available from the owner, state or federal offices regarding the design, construction, or any other repairs or modifications to this dam.

b. Adequacy: The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data and is based primarily on the visual inspection, the past performance history and sound engineering judgment.

c. Validity: Due to the lack of available data, the conclusions and recommendations found in this report are based on the visual inspection and hydraulic/hydrologic computations.

SECTION 3

VISUAL INSPECTION

3.1 Findings:

a. General: As a result of the visual inspection and general appearance, the dam, dike, and spillway are all judged to be in POOR condition.

An inspection of the Mashapaug Pond facilities was performed on December 2, 1980 by Lenard & Dilaj Engineering, Inc., with the assistance of Geotechnical Engineers, Inc. The weather was cloudy and the temperature was about 25°- 35° F. Water level in the pond at the time of inspection was about 2 feet below spillway crest level. No flow was being discharged through either the spillway or outlet works.

The three separate structures, namely, the earth dam with the outlet works, the earth dike, and the concrete spillway were all inspected separately. Each of these structures is a separate entity, yet impounding the same body of water. At the time of the inspection, the water in the reservoir was about 7 feet below the crest of the dam and of the dike, and approximately 2 feet below the spillway crest. The elevation of the crest of the dam and dike is approximately 3 feet higher than the abutments of the spillway structure.

b. Dam: The dam is an earth embankment. No construction drawings are available nor are the details of design known. The dam is 290 feet long, 20 feet wide at the crest, and 21 feet high at the outlet structure.

1. Crest: An unpaved roadway traverses the crest of the dam serving residences along the lake shore and providing access to the outlet structure. Towards the right abutment the crest is approximately 0.7 feet higher than at the left abutment. The roadway swings around the outlet structure as shown on Photos 1 and 4. There is no evidence of any recent overtopping of the dam,and no signs of erosion or ruts along the crest.
2. Upstream slope: The upstream slope is about 1¼H:1V and is covered with hand placed riprap (Photo 3). As shown on Photo 3, there are concrete blocks placed on the opposite upstream side

of the intake structure. The purpose of this construction is not known. There is a twin tree growing on this slope which has a nail used as a marker to indicate high water. When water reaches this level, the outlet gate valves are opened. Numerous trees are growing on the entire upstream slope, ranging from small sizes up to 18 inches in diameter.

The intake to the outlet structure is located beneath the water level in the pond and about 50 feet out from the shore. Its condition could not be ascertained during the inspection.

3. Downstream slope: The downstream slope is about 1.3H:1V and is heavily overgrown with trees and brush (Photo 5). There is no apparent seepage on the slope, but there is extensive seepage along the entire length of the toe. Standing water downstream of the dam makes it difficult to estimate seepage flow. Seepage can be observed clearly only at locations where the flow is concentrated. Photo 8 shows the general seepage area left of the downstream outlet structure and Photo 7 shows a close-up of the right downstream wing wall. The seepage along the base of the wall can be clearly noted. There are a number of locations where the seepage is so concentrated that, even though it is obscured by tail water, the flow can be clearly noted (Photo 10). Although no soil movement could be observed, the soil through which the seepage exits appeared to be a clean gravelly sand or sandy gravel, possibly the result of the fines having been washed out of the original soil. Due to the presence of the tail water from Lower Mashapaug Pond, the quantity of seepage could not be estimated.

4. Outlet structure: There is a gate structure on the downstream side of the dam crest which appears to be in good condition. The two 30-inch pipes are continuously under pressure from the intake to the downstream side of the crest. The gates were not operated during the inspection.

   The structure consists of a wet masonry well approximately 10 feet in diameter with two gate valves inside. On the ground surface, there is a wood frame structure with a padlock (Photo 4). The outlet structure (Photo 5) was capped with concrete, as shown on Photo 6, approximately 4 or 5 years ago. The original headwall structure appears to be a stone masonry construction. There are numerous

hairline cracks in the concrete wall. The outlet opening is rectangular, 5 feet wide and 3 feet high. There are no weep holes on this new concrete facing at the outlet works. Minor efflorescence was observed on the concrete capping.

c. Dike: The dike at Mashapaug Pond is an earth embankment structure approximately 500 feet long, 15 feet high at the center, and 14 feet wide at the crest. There are no plans or construction drawings available nor are the details of design known.

1. Crest: An unpaved roadway traverses the crest of the dike as shown on Photo 14. This road appears to be used by lakeside residents. Toward the left abutment a third of the dike is approximately one foot lower than the right abutment. The roadway is in fairly good condition with an even surface.

2. Upstream slope: The entire slope is overgrown with trees and brush. In one area along the right abutment, the slope protection consists of hand placed riprap about 150 feet long on a 2H:1V slope (Photo 12). For the remaining length of the dike, however, the slope is steeper, about 1½H:1V, and the riprap has the appearance of having been dumped (Photos 11 and 13). The dumped appearance of the riprap is possibly the result of sloughing of the slope and distortion of the original hand placed riprap. Locally at numerous locations one could observe the remains of stone walls that had been built on the upstream slope (Photo 11). Many of these stone walls have collapsed (Photo 13); erosion of the slope and crest was observed behind these collapsed walls (Photo 13). The soil exposed in the eroded areas consisted of a silty, gravelly sand. At the locations of the collapsed stone walls the crown of the dike was noted to be lower than in other areas. It was also noted that at these same locations trees were cut prior to the construction of the walls. It is possible that the trees held back the erosion and that once they were cut, erosion occurred and the walls sloughed. These block walls are constructed of cut stone slabs and reinforced concrete blocks, probably salvage material from old buildings.

3. Downstream slope: The downstream slope is irregular with an inclination ranging from 1½H:1V to 1H:1V. Extensive tree and brush growth was observed with trunk diameters of up to 18 inches.

Some of the tree trunks are bent in the lower part with a concave upwards shape indicating some creep deformations of the slope.There is no seepage on the slope, but there is extensive seepage at the toe. Along the entire downstream slope there is an extensive swampy area which is fed by a stream from a separate watershed and by the seepage from Mashapaug Pond. The tail water against the dike obscured the seepage; however, locally, the seepage is evident (Photo 15). Because of the leaf cover and the presence of the tail water it could not be ascertained whether soil was being transported by the seepage, nor could the amount of seepage be estimated. Along the lower part of the downstream embankment, numerous small gullies, which represent minute sloughing at each individual location, were noted. Some of these could be due to frost action. There are no appurtenant works at this location.

d. Spillway: The spillway is a concrete structure situated on bedrock and located at the extreme southerly end of the pond. It is 60 feet long and 10 feet high. The crest section of the spillway is 2 feet lower than the two abutments and 25 feet long. The upstream face of the structure was covered by accumulated sands (Photo 22). Indications are that a cap was poured over an original spillway at the same location. As shown on the overview photo, there is a long, continuous crack immediately beneath the cap of the spillway (see also Photos 17 and 19).

The downstream face shows severe spalling with a large horizontal crack (Photos 17 and 18). Concrete has been removed from this crack underneath the spillway cap. Some of the holes are 8 inches deep and, at certain locations, a ruler can be inserted to a depth of 1 to 1½ feet (Photo 19). A short section of the wall near the left abutment is separated from the rest of the structure by a large crack with apparent horizontal displacement of a few inches across the crack. Minor seepage is emanating at this location (Photo 20). The amount could not be estimated due to the presence of the tail water.

About 30 feet downstream of the spillway, in the discharge channel, there is rust colored standing water, possibly the result of seepage through the bedrock foundation (Photo 21).

e. Reservoir Area: There is considerable siltation upstream of the spillway structure. There are no indications of instability along the reservoir edge in the vicinity of the dam, dike, or spillway.

f. Downstream Channel: The downstream channel for the spillway is Bigelow Brook, which is a steep narrow channel with bedrock exposed at the bottom near the spillway. There is no clearly defined downstream channel for the outlet structure, since it discharges into Lower Mashapaug Pond.

3.2 Evaluation: The dam, dike and spillway are judged to be in POOR condition because of the following:

a. The extensive seepage observed downstream of the dam and dike represent a potential for piping, erosion, and embankment instability, particularly because of the steepness of the slopes.

b. The extensive tree growth on the dam and dike represents a risk of damage due to tree uprooting during storms or to seepage along rotten and decaying roots.

c. The erosion of areas of the dike crest can result in a significant local reduction of freeboard.

d. The irregularity of the surface and the apparent creep of the downstream slope of the dike indicates insufficient stability.

e. The deterioration of the concrete spillway structure can eventually result in its failure, most probably during high spillway flows.

f. The two pipes which pass through the dam are continually under pressure, since the control valves are located on the downstream side, and could present a problem if they were to deteriorate and leak. Water passing outside the pipes could lead to piping and erosion, thereby presenting stability problems for the dam embankment.

SECTION 4

OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures:

a. General: The pond level is controlled by the Manager of Facilities Engineering of American Optical Company of Southbridge, Massachusetts. During late fall, the pond level is lowered to an elevation of approximately 2 feet below spillway flow in order to protect the waterfront facilities. During the spring, the water level is raised to elevation 706 feet which is the crest elevation of the spillway. In case water rises to a higher elevation which is marked by a nail in a tree opposite the outlet structure (this is above the previously mentioned nail which marks the spillway elevation), the gate valves are opened to lower the water level.

b. Description of Any Warning System in Effect: No formal emergency or contingency plan is in effect at this site. Upon radio announcement of intense storm activity, the gate valves are usually opened.

4.2 Maintenance Procedures:

a. General: As discussed in Section 3 of this report, the embankments of both the dam and dike were extensively overgrown with vegetation. Maintenance at the site is limited and not implemented on a regular basis. Irregular maintenance appears to be accomplished when staff resources permit and extraordinary need arises.

b. Operating Facilities: The gate valves are operated fairly frequently and the structure housing the valves is maintained in good condition. As stated in Section 3, the spillway structure is in a state of disrepair.

4.3 Evaluation: A program of regular operational checks of the gate valves at the outlet works has not been developed or implemented. Maintenance procedures of the spillway, dam, dike, and approach and discharge channels must be established. A formal program of operation and maintenance procedures should be implemented, including documentation to provide complete records for future reference. Also, a downstream warning system should be developed and implemented, particularly because of the serious effects of a breach in either the dam or dike.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General: The facilities at Mashapaug Pond include an earth embankment dam with a downstream concrete wall outlet structure, an earth embankment dike, and a reinforced concrete spillway. As previously mentioned, these structures are all separated by long distances with the spillway being on the southerly side of the pond and the dam and dike on the northerly end. The dam is 290 feet long and 21 feet high at the outlet and the dike is 500 feet long and 15 feet high. The spillway crest has a width of 25 feet, is 2 feet below the abutments, and 8 feet above the streambed. For purposes of hydraulic calculations, the spillway was considered as a broad crested weir. Calculated discharge over this spillway structure includes flow over the abutments (as noted in Appendix D), which are of similar construction to the crest and anchored to bedrock on either side of the stream. Additional discharge capacity is available through two 30-inch pipes passing through the dam at the north end of the pond. The outlet pipes are controlled, whereas discharge over the spillway is not. In order to visualize the flow out of this facility, it should be noted that the spillway crest elevation is 706.0 feet, the abutment elevation is 708.0 feet, the top of the dam and dike at the north end is at 710.8 feet, and the invert elevation of the pipes is 689.7 feet.

The spillway discharge channel (Bigelow Brook) is about 25 feet wide at the base of the structure and converges to a 10 foot width a short distance downstream. It is a very irregular channel with exposed bedrock, many cobbles, and embankments overgrown with trees. The brook continues at this width and with similar channel characteristics to a point about 2,500 feet downstream where it discharges into Bigelow Pond, still within the confines of Bigelow Hollow State Park. At the northerly end of the pond, the outlet works discharges into Lower Mashapaug Pond which controls the level of the tailwater against the dam and dike. The outlet from the two pipes is submerged and located in a rather swampy backwater area of the lower pond. It should be noted that this lower pond is created by a dam located at the northerly end of a culvert passing beneath I-86 (Wilbur Cross Parkway).

The watershed covers an area of 4.7 square miles, consisting basically of wooded terrain with moderate to steep slopes. Only small portions of it are developed along major roads passing through the area. Although a few cottages and permanent homes are located around the shores of

the pond, it is basically undeveloped and expected to remain as such because of the state controlled land, which is comprised of Bigelow Hollow State Park and the Nipmuck State Forest.

At normal pool level, set by the spillway crest elevation, Mashapaug Pond has a storage capacity of 5,290 acre feet. This increases to 6,725 acre feet at the top of the dam and 7,214 acre feet at the test flood level. Surcharge storage to the top of the dam and test flood level, therefore, is 1,436 and 1,925 acre feet, respectively.

5.2 Design Data: No design data was available for the facilities at Mashapaug Pond.

5.3 Experience Data: No records on past experience were found to be available for this site.

5.4 Test Flood Analysis: Based on the "Recommended Guidelines for Safety Inspection of Dams", all three structures are classified as INTERMEDIATE in size. In addition, the dam and dike are classified as having a HIGH hazard potential, while that for the spillway is LOW. The test flood for these conditions is the Probable Maximum Flood (PMF).

Using the HEC-1 Flood Hydrograph Computer Program developed by the Army Corps of Engineers for dam safety investigations, the inflow and routed outflow for the test flood were found to be 7,800 cfs (1,660 CSM) and 6,100 cfs, respectively. Water level in the pond at the time when the routing began was assumed to be at 706 feet. As a basis of comparison, the ½ PMF resulted in an inflow of 3,890 cfs and an outflow of 1,400 cfs. The outflow capacity of the structures at Mashapaug Pond (including the spillway and outlet works) is 1,550 cfs at the level of the top of the dam and dike, which represents 25% of the test flood outflow. The maximum overtopping associated with the test flood outflow is 1.5 feet over the level of the dam and dike. This means that the abutments of the spillway structure would be overtopped by 4.3 feet.

Although the storage areas within the basin do not have a major impact on the test flood flows, the storage in Mashapaug Pond itself is quite significant and due in part to the difference in elevation between the spillway crest and the top of the dam and dike. Calculations for the above mentioned data, together with a computer printout of results, is included in Appendix D of this report.

5.5 Dam Failure Analysis: A failure analysis was performed using the "Rule of Thumb" method for estimating downstream dam failure hydrographs, as developed by the Corps of Engineers. Failure discharge calculations were determined for all three structures. The discharge from the spillway structure was found to be 915 cfs with water level at the top of the abutments at elevation 708.0 feet. Because of this limited outflow and lack of any significant downstream development, no further analysis was performed.

The failure discharge of the dam was calculated to be 7,120 cfs with water level at the crest elevation of the dam at 710.8 feet. Although the structure is 21 feet high from the outlet discharge to the top of the dam, its effective height for this calculation was limited by the tail water elevation of Lower Mashapaug Pond to 15 feet. The dike's failure discharge was found to be 18,400 cfs with water level at the dike crest elevation of 710.8 feet. Since both the dam and the dike discharge into the same downstream channel and since the outflow from the dike represented the greater danger, the downstream failure analysis was performed using the discharge from the dike breach.

Failure was assumed to occur when water level in the pond was at the top of the dike. The dam outlet structure's discharge just prior to the dike failure would be 250 cfs, which could increase the level of Lower Mashapaug Pond by approximately 3 feet (taking into consideration the storage of the pond area). This is due to the fact that the dam controlling the level of this lower pond is on the north side of the I-86 culvert, and the flow of 250 cfs approaches the discharge capacity of the culvert. The increase in water level of Hamilton Reservoir due to the 250 cfs discharged from the outlet structure would be negligible.

The calculated dike failure discharge of 18,400 cfs could produce an increase in depth at the lower pond of 14 feet, taking into consideration the cross sectional areas available for flow over and under I-86. This could also mean a depth of flow over I-86 of as much as 10 feet in some areas of the intersection located at the stream crossing. The increase in water level of Hamilton Reservoir would range from about 6 feet at the southerly end to 4 feet at the northerly end as the wave is routed through the reservoir. Flood effects would continue from this point until the stream eventually discharges into the East Brimfield Flood Control Reservoir located in Holland and Brimfield, Massachusetts. The depth of flow just prior to discharge into this area would be approximately 9 feet (indicating an increase in depth of about 8 feet). The analysis covered a distance of 4.5 miles downstream, as shown by the calculations in Appendix D.

The 250 cfs discharge from the outlet works at the dam would produce prefailure depths of 3 feet at the I-86 culvert, but would not flood the highway, its two access roads or the two adjacent local roads. Post failure depths at these same locations would be increased by about 13 feet, indicating flooding of these roads by about 9 feet of water. Prefailure depths at the other three local roads would be at the level of Hamilton Reservoir, since the storage available there would render any depth increase, due to the 250 cfs outflow at the dam,negligible. It is estimated, therefore, that post failure depths at the three remaining local roads would be about 4 feet over the crest of the road. The increase in water depths at the homes and commercial establishments near I-86 would range from 2 to 8 feet, with no flooding due to the dam outflow prior to failure. The greatest damage to homes would be around the perimeter of the Hamilton Reservoir. Since the prefailure flow of 250 cfs from the outlet works at the dam would produce a negligible increase in depth of the reservoir, the post failure depth of 4 to 6 feet would mean that many of the houses could be flooded by as much as 2 to 4 feet.

The breach of the dam could, therefore, cause appreciable damage to five homes and two commercial establishments in the vicinity of Lower Mashapaug Pond, to I-86 and its two access roads, to the numerous homes around Hamilton Reservoir and between Hamilton Reservoir and the East Brimfield Flood Control Reservoir (as many as 100 homes could be affected), and to five local roads. Because of the storage capacity of Mashapaug Pond, the duration of substantial flows could last for several hours. It is expected that the dike failure could result in the loss of more than a few lives.

Based upon the failure analysis, both the Mashapaug Pond Dam and Mashapaug Pond Dike are classified as having a HIGH hazard potential and Mashapaug Pond Spillway is classified as having a LOW hazard potential.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations: There are indications of creep and minor sloughing in the downstream slope of the dike. The extensive seepage downstream of the dam and dike represents a threat to their future stability. The fact that the two pipes passing through the dam are continuously under pressure could also present a problem. Piping and erosion from water leaking out through the pipes could also threaten the stability of the dam.

6.2 Design and Construction Data: There was no design and construction data available at the time of inspection except for a 1979 drawing of the spillway showing a proposed modification of the weir, which has not been carried out.

6.3 Post Construction Changes: There is no available information on post construction changes. The outlet structure and gatehouse have apparently been repaired sometime in the last few years.

6.4 Seismic Stability: The dam is located near the boundary between Seismic Zones 1 and 2 and, in accordance with the Phase I inspection guidelines, does not warrant seismic stability analysis.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment:

a. Condition: On the basis of the visual inspection, the dam, dike, and spillway structure are judged to be in poor condition because of the following:

1. The extensive seepage observed downstream of the dam and dike represents a potential for piping, erosion, and embankment instability, particularly because of the steepness of the slopes of the dam and dike.

2. The extensive tree growth on the dam and dike represents a risk of damage due to tree uprooting during storms or to seepage along rotten and decaying roots.

3. The erosion of certain areas of the dike crest can result in a significant local reduction of freeboard.

4. The irregularity of the surface and the apparent creep of the downstream slope of the dike indicates insufficient stability.

5. The deterioration of the concrete spillway structure can eventually result in its failure, most probably during high spillway flows.

6. There is, presently, inadequate spillway capacity to pass the design flood without overtopping the dam and dike.

b. Adequacy of Information: There was no design or construction data available. Thus, the assessment of the condition of the dam and appurtenant structures is based only on the visual inspection.

c. Urgency: The recommendations presented below should be carried out within one year after receipt of this report by the owner.

7.2 Recommendations: The following should be carried out under the direction of a qualified registered engineer:

a. Investigate the significance of the seepage downstream

of the dam and dike and, if appropriate, design seepage control measures to prevent the possibility of erosion and piping. Develop a system and schedule to monitor seepage downstream of the dam and dike.

b. Analyze the stability of the dam and dike.

c. Remove trees and their stumps from the dam and dike, backfilling the holes with suitable materials after analyzing for stability and only under the direct supervision of an engineer. Also regrade the low areas and eroded areas along the crest of the dam and dike.

d. Establish measures to control erosion of the crest and downstream slopes of the dam and dike.

e. Repair the cracks and spalling in the spillway structure.

f. Perform a detailed hydrologic/hydraulic investigation to assess further the potential of overtopping the dam and the need for and the means to increase project discharge capacity.

g. Place riprap along the bare areas of the upstream slope of the dike and repair the riprap in areas where sloughing has occurred.

h. Investigate the feasibility of providing control of the two discharge pipes at the dam at the upstream side of the structure.

7.3 Remedial Measures:

a. Establish a warning program for downstream inhabitants in case of an emergency.

b. Establish a program of annual technical inspections by qualified engineers.

c. Maintain the dam and dike slopes and crest clear of trees and brush.

7.4 Alternatives: There are no practical alternatives to the recommendations of Sections 7.2 and 7.3.

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT *MASHAPAUG DAM*

DATE *DECEMBER 2, 1980*

TIME *8:30 a.m.*

WEATHER *cloudy*

W.S. ELEV. ________ U.S. ______ DN.S.

PARTY:

1. *John Lenard, L.D.E.I.*
2. *Michael Dilaj, L.D.E.I.*
3. *Karl Acimovic, L.D.E.I.*
4. *Kent Healy, L.D.E.I.*
5. *Gonzalo Castro, G.E.I.*
6.
7.
8.
9.
10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	*Structural*	*John Lenard*	
2.	*Geotechnical*	*Kent Healy, Gonzalo Castro*	
3.	*Hydrology/Hydraulics*	*Michael Dilaj, Karl Acimovic*	
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECKLIST

PROJECT *MASHAPAUG POND DAM* DATE *DECEMBER 2, 1980*

PROJECT FEATURE ______ NAME ______

DISCIPLINE ______ NAME ______

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	*None observed*
Pavement Condition	*Not applicable*
Movement or Settlement of Crest	*Too irregular to judge*
Lateral Movement	*Too irregular to judge*
Vertical Alignment	*Too irregular to judge*
Horizontal Alignment	*Too irregular to judge*
Condition at Abutment and at Concrete Structures	*Good. Seepage at left outlet wall.*
Indications of Movement of Structural Items on Slopes	*Not applicable*
Trespassing on Slopes	*Several footpaths*
Sloughing or Erosion of Slopes or Abutments	*Erosion of crest end of downstream slopes*
Rock Slope Protection - Riprap Failures	*Hand placed riprap. Good condition.*
Unusual Movement or Cracking at or Near Toe	*None observed.*
Embankment or Downstream Seepage	*Extensive seepage at toe and downstream of dam.*
Piping or Boils	*None observed*
Foundation Drainage Features	*None known*
Toe Drains	*None known*
Instrumentation System	*None*
Vegetation	*Heavy growth on both slopes*

PERIODIC INSPECTION CHECKLIST

PROJECT *MASHAPAUG DAM* DATE *DECEMBER 2, 1980*

PROJECT FEATURE ______ NAME ______

DISCIPLINE ______ NAME ______

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	*None observed*
Pavement Condition	*Not applicable*
Movement or Settlement of Crest	*Too irregular to judge*
Lateral Movement	*Too irregular to judge*
Vertical Alignment	*Too irregular to judge*
Horizontal Alignment	*Too irregular to judge*
Condition at Abutment	*Good*
Indications of Movement of Structural Items on Slopes	*Not applicable*
Trespassing on Slopes	*Several footpaths on slopes*
Sloughing or Erosion of Slopes or Abutments	*Severe erosion of both slopes and of crest.*
Rock Slope Protection - Riprap Failures	*Riprap failures caused by sloughing*
Unusual Movement or Cracking at or Near Toes	*None observed*
Embankment or Downstream Seepage	*Extensive seepage at toe and downstream of dam.*
Piping or Boils	*None observed*
Foundation Drainage Features	*None known*
Toe Drains	*None known*
Instrumentation System	*None known*
Vegetation	*Heavy tree growth.*

PERIODIC INSPECTION CHECKLIST

PROJECT *MASHAPAUG DAM*	DATE *DECEMBER 2, 1980*
PROJECT FEATURE	NAME
DISCIPLINE	NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	*Under water, not observable*
a. Approach Channel	
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
b. Intake Structure	
Condition of Concrete	
Stop Logs and Slots	

PERIODIC INSPECTION CHECKLIST

PROJECT *MASHAPAUG DAM* DATE *DECEMBER 2, 1980*

PROJECT FEATURE ______ NAME ______

DISCIPLINE ______ NAME ______

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	*Gate structure*
a. Concrete and Structural	*Stone masonry*
General Condition	*Good*
Condition of Joints	*Not applicable*
Spalling	*None observed*
Visible Reinforcing	*Not applicable*
Rusting or Staining of Concrete	*Not applicable*
Any Seepage or Efflorescence	*Observable part is above water level in reservoir*
Joint Alignment	*Not applicable*
Unusual Seepage or Leaks in Gate Chamber	*Observable part is above water level.*
Cracks	*None observed*
Rusting or Corrosion of Steel	*None observed*
b. Mechanical and Electrical	*Not applicable*
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System	

PERIODIC INSPECTION CHECKLIST

PROJECT *MASHAPAUG DAM* DATE *DECEMBER 2, 1980*

PROJECT FEATURE ______ NAME ______

DISCIPLINE ______ NAME ______

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	*Not applicable*
General Condition of Concrete	
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

PERIODIC INSPECTION CHECKLIST

PROJECT *MASHAPAUG DAM* DATE *DECEMBER 2, 1980*

PROJECT FEATURE ______ NAME ______

DISCIPLINE ______ NAME ______

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	*Good. Concrete cap placed ~4 years ago*
Rust or Staining	*None observed*
Spalling	*Minor spalling at tail waterline*
Erosion or Cavitation	*None observed*
Visible Reinforcing	*None observed*
Any Seepage or Efflorescence	*Some local efflorescence*
Condition at Joints	*Not applicable*
Drain holes	*None observed*
Channel	*Swampy area downstream*
Loose Rock or Trees Overhanging Channel	*Not applicable*
Condition of Discharge Channel	*Not applicable*

PERIODIC INSPECTION CHECKLIST

PROJECT *MASHAPAUG DAM* DATE *DECEMBER 2, 1980*

PROJECT FEATURE ______ NAME ______

DISCIPLINE ______ NAME ______

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	*No approach channel. Open beach area with sand almost to weir level*
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Approach Channel	
b. Weir and Training Walls	*No training walls, exposed bedrock at both ends of spillway structure.*
General Condition of Concrete	*Poor*
Rust or Staining	*None observed*
Spalling	*Extensive, particularly along construction joints*
Any Visible Reinforcing	*None observed*
Any Seepage or Efflorescence	*Some seepage, extensive efflorescence*
Drain Holes	*None on spillway wall*
c. Discharge Channel	*Natural stream bed*
General Condition	*Fair*
Loose Rock Overhanging Channel	*None observed*
Trees Overhanging Channel	*Several trees*
Floor of Channel	*Bedrock and boulders*
Other Obstructions	*None observed*
Other Comments	

PERIODIC INSPECTION CHECKLIST

PROJECT *MASHAPAUG DAM* DATE *DECEMBER 2, 1980*

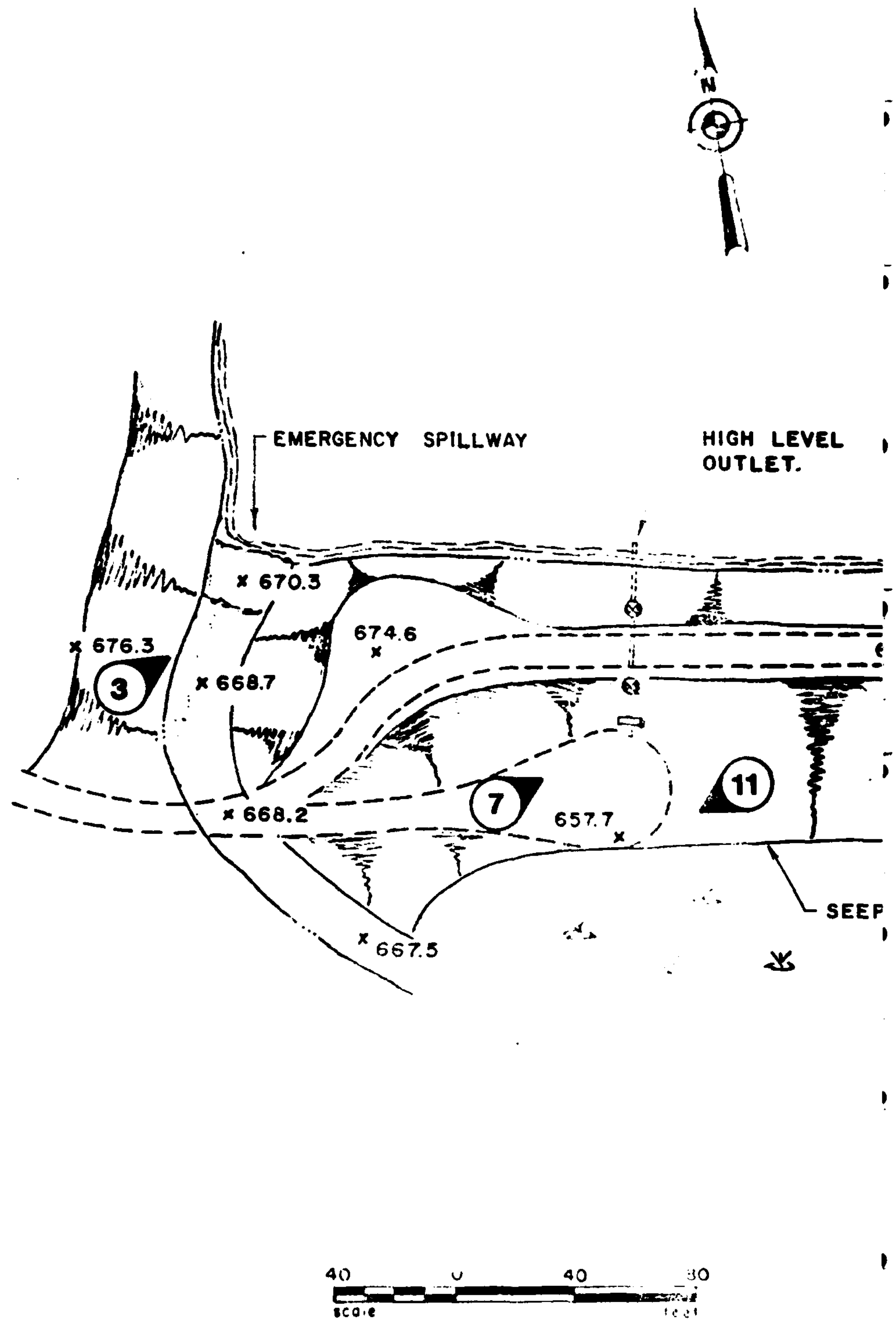
PROJECT FEATURE ______ NAME ______

DISCIPLINE ______ NAME ______

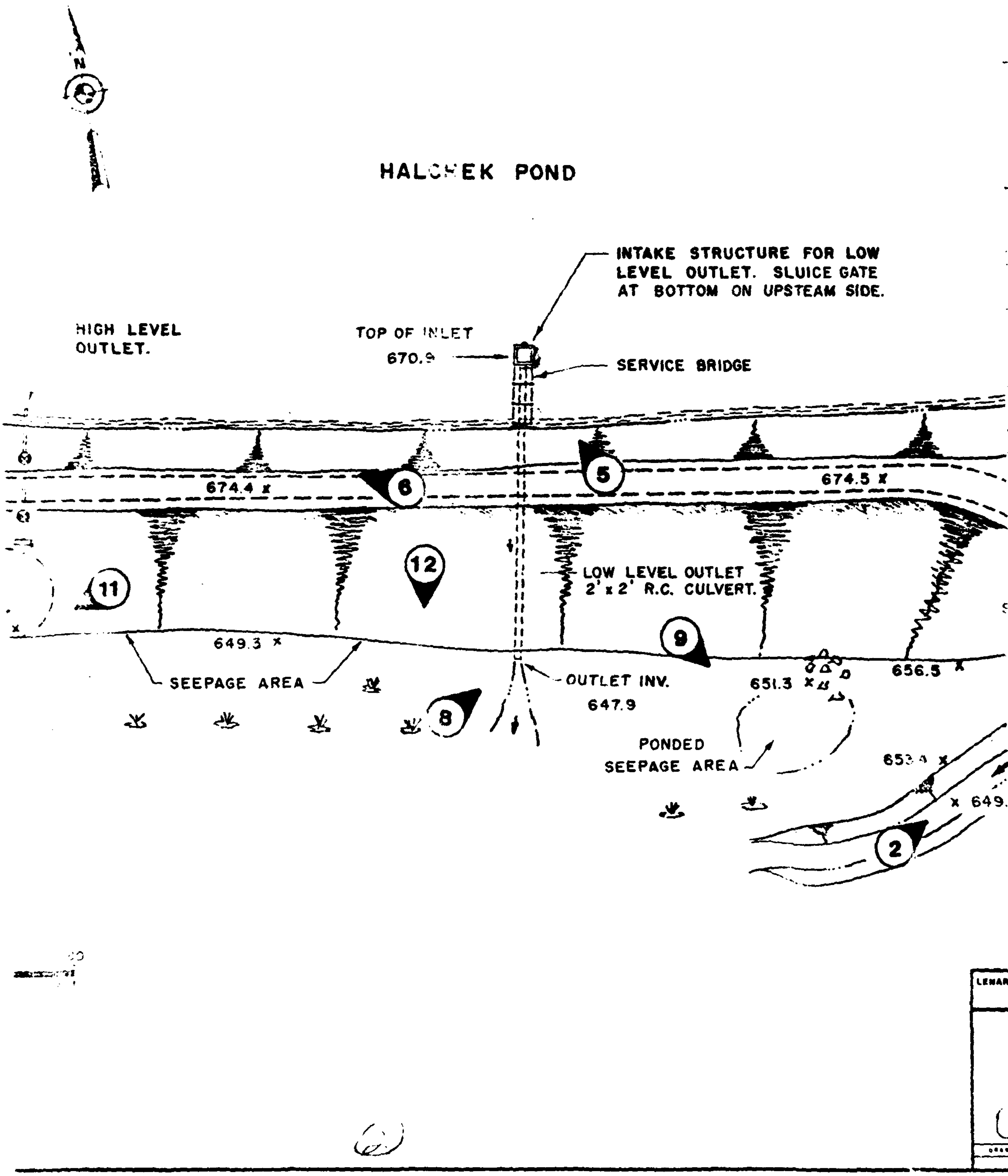
AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SERVICE BRIDGE</u>	*There is no service bridge.*
a. Super Structure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Underside of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

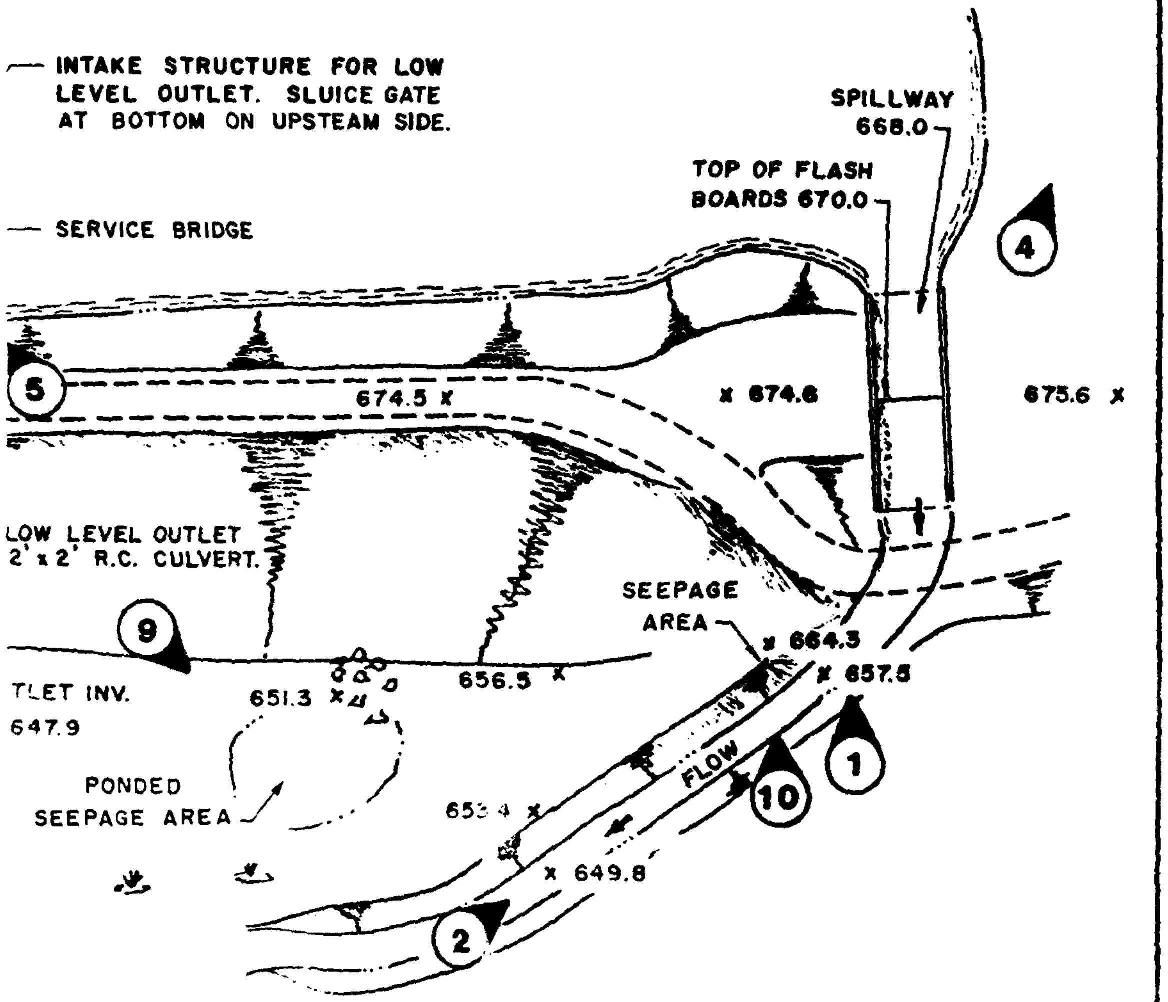
APPENDIX B

ENGINEERING DATA



N
EMERGENCY SPILLWAY
HIGH LEVEL
OUTLET.
670.3
676.3
674.6
3
668.7
7
11
668.2
657.7
SEEP
667.5
40
0
40
80
scale
feet


N
HALCHEK POND
INTAKE STRUCTURE FOR LOW LEVEL OUTLET. SLUICE GATE AT BOTTOM ON UPSTEAM SIDE.
HIGH LEVEL OUTLET.
TOP OF INLET
670.9
SERVICE BRIDGE
674.4 x
674.5 x
6
5
12
11
LOW LEVEL OUTLET 2' x 2' R.C. CULVERT.
9
649.3 x
SEEPAGE AREA
OUTLET INV.
647.9
651.3 x
656.5 x
8
PONDED SEEPAGE AREA
2



LENARD DILAJ ENGINEERING, INC.
STORRS, CONNECTICUT
ENGINEERS

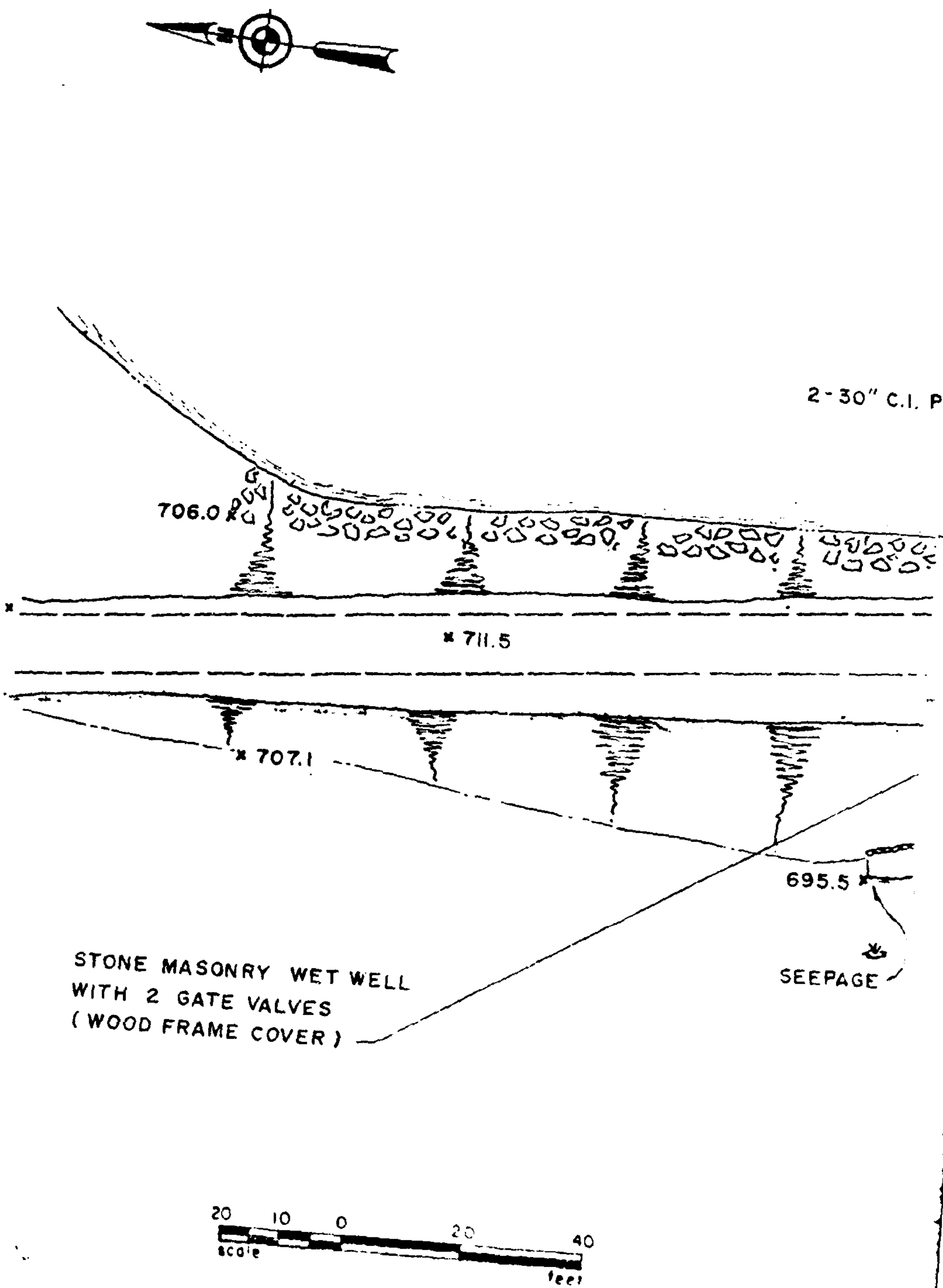
US ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

PHOTO INDEX
HALCHEK POND DAM
WILLINGTON, CT

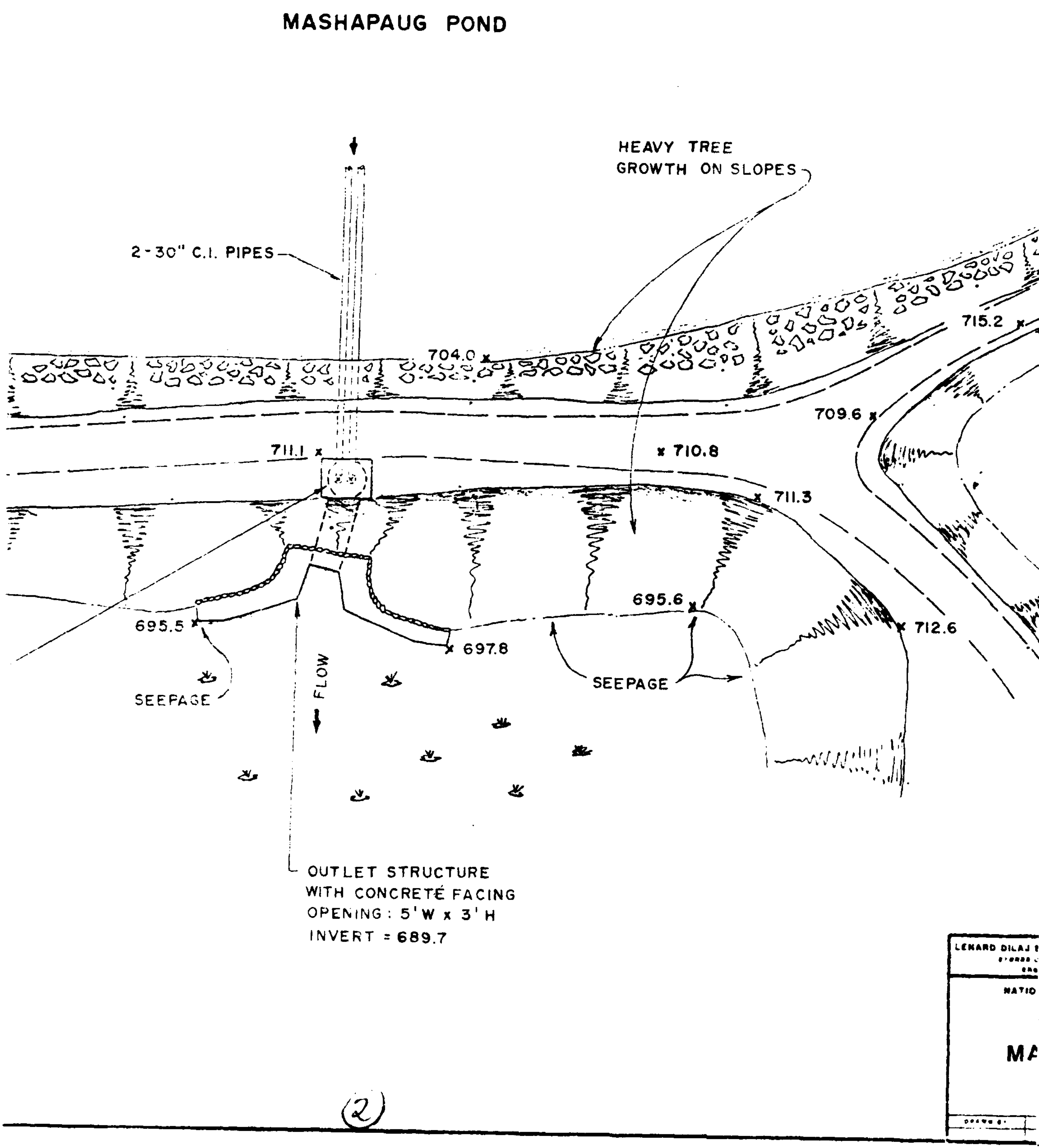
(3)

DRAWN BY	CHECKED BY	APPROVED BY	SCALE	
			DATE	SHEET



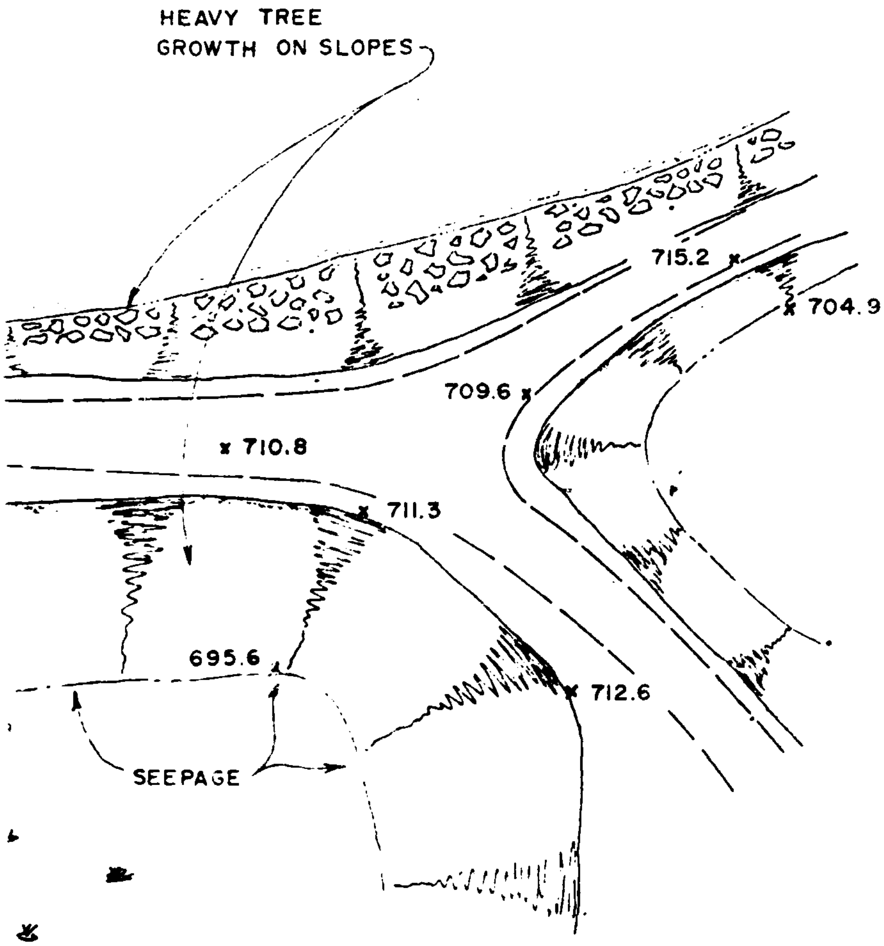
2-30" C.I. P
706.0
711.4
711.5
707.1
695.5
SEEPAGE
STONE MASONRY WET WELL
WITH 2 GATE VALVES
(WOOD FRAME COVER)
20 10 0 20 40
scale
feet

①



MASHAPAUG POND
HEAVY TREE GROWTH ON SLOPES
2-30" C.I. PIPES
704.0
715.2
709.6
711.1
710.8
711.3
695.6
695.5
697.8
712.6
FLOW
SEEPAGE
SEEPAGE
OUTLET STRUCTURE
WITH CONCRETE FACING
OPENING: 5'W x 3'H
INVERT = 689.7
LENARD DILAJ
NATIO
MA

(2)



LENARD DILAJ ENGINEERING, INC.	US ARMY ENGINEER DIV. NEW ENGLAND
STORRS, CONNECTICUT	CORPS OF ENGINEERS
ENGINEER	WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

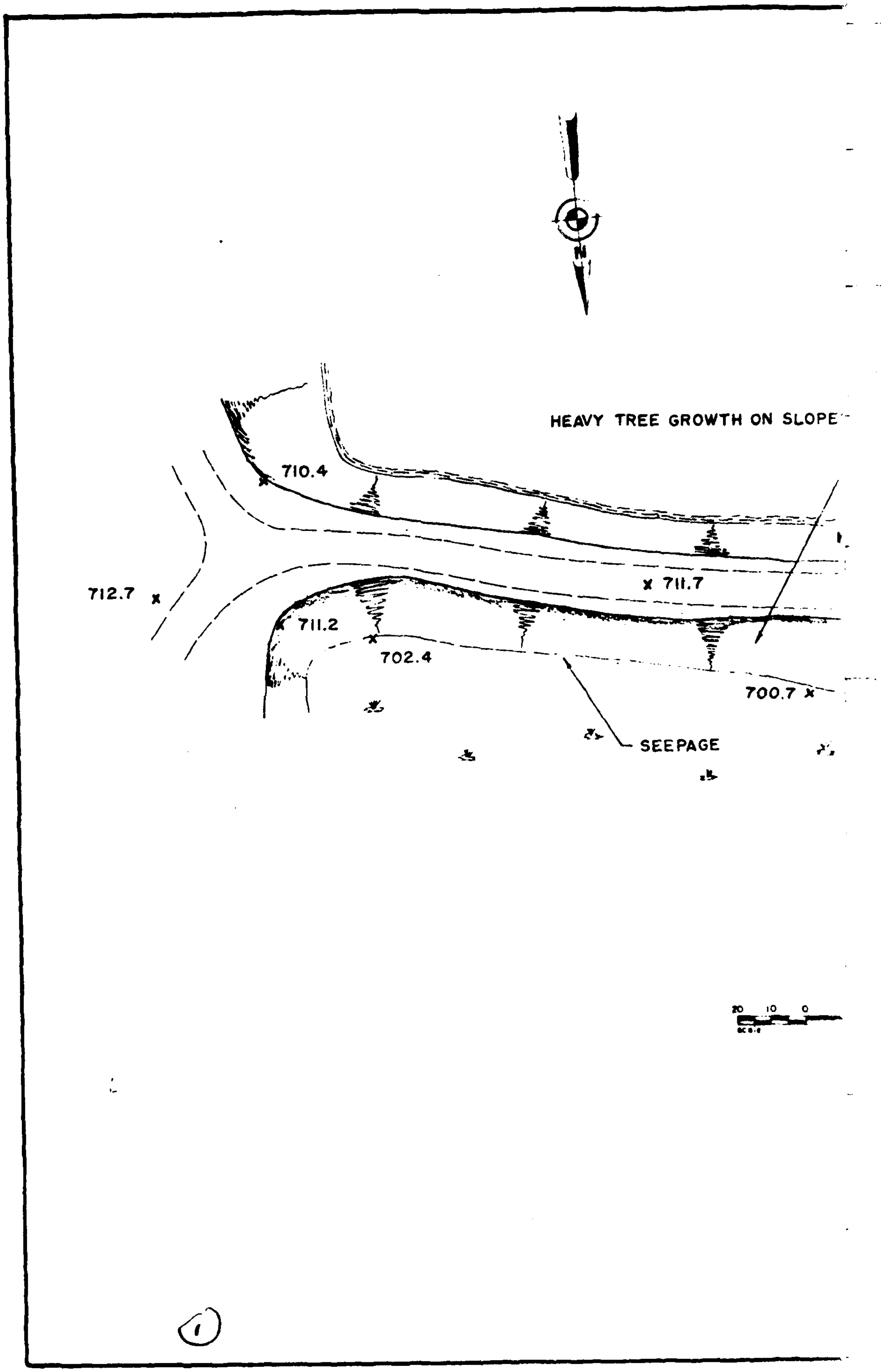
SITE PLAN

MASHAPAUG POND DAM

UNION, CT.

DRAWN BY	CHECKED BY	APPROVED BY	SCALE
			DATE

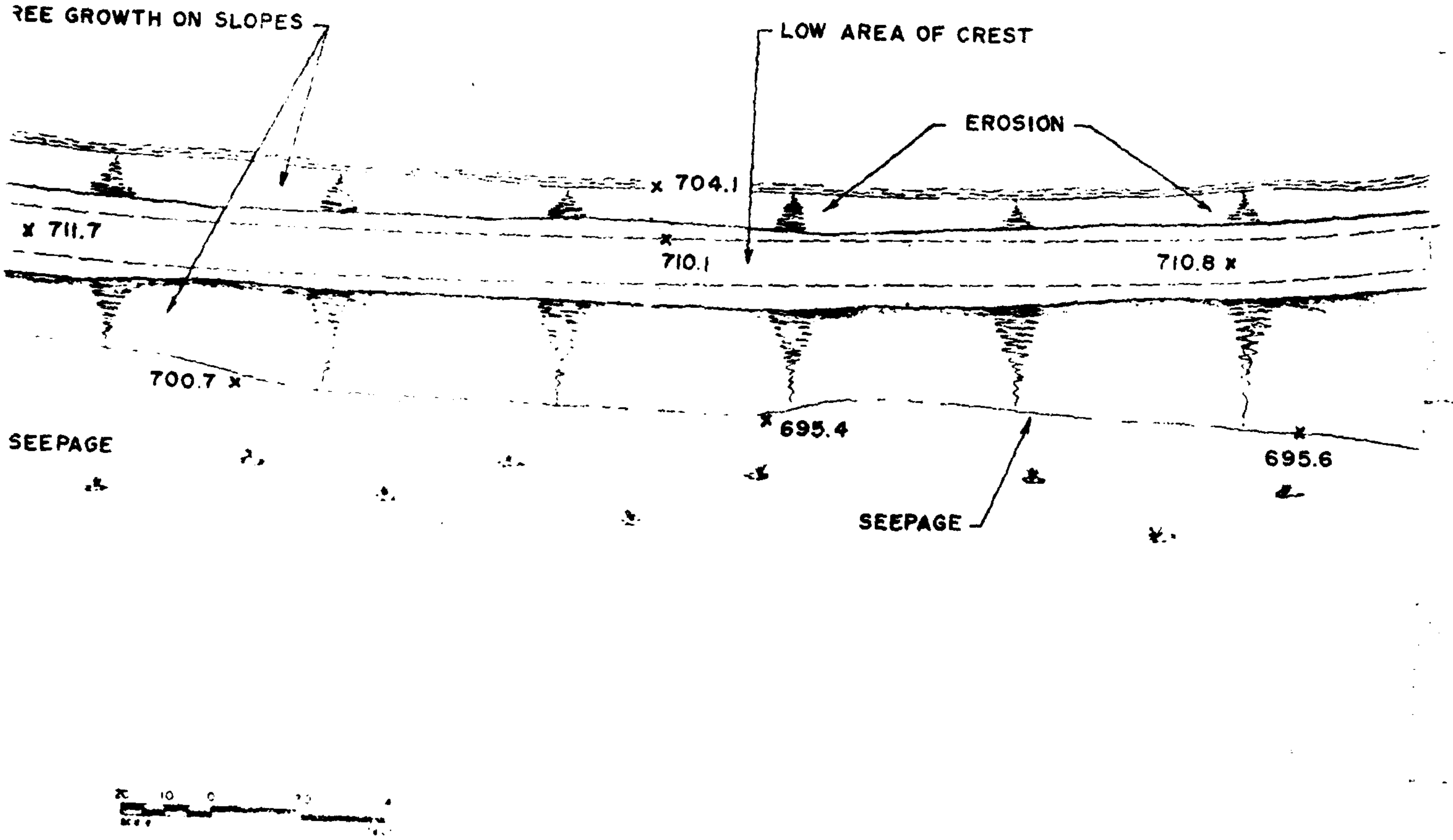
3

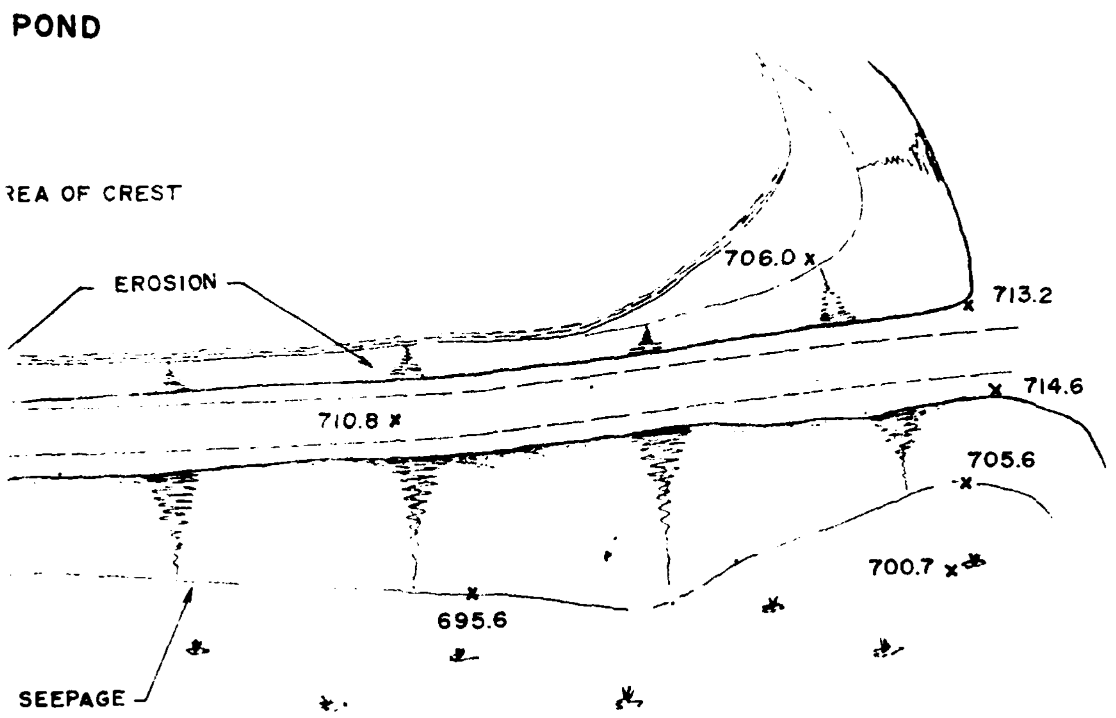


N
HEAVY TREE GROWTH ON SLOPE
710.4
712.7
711.7
711.2
702.4
700.7
SEEPAGE
20 10 0

1

MASHAPAUG POND





LENARD DILAJ ENGINEERING, INC. STORRS, CONNECTICUT ENGINEERS	US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS

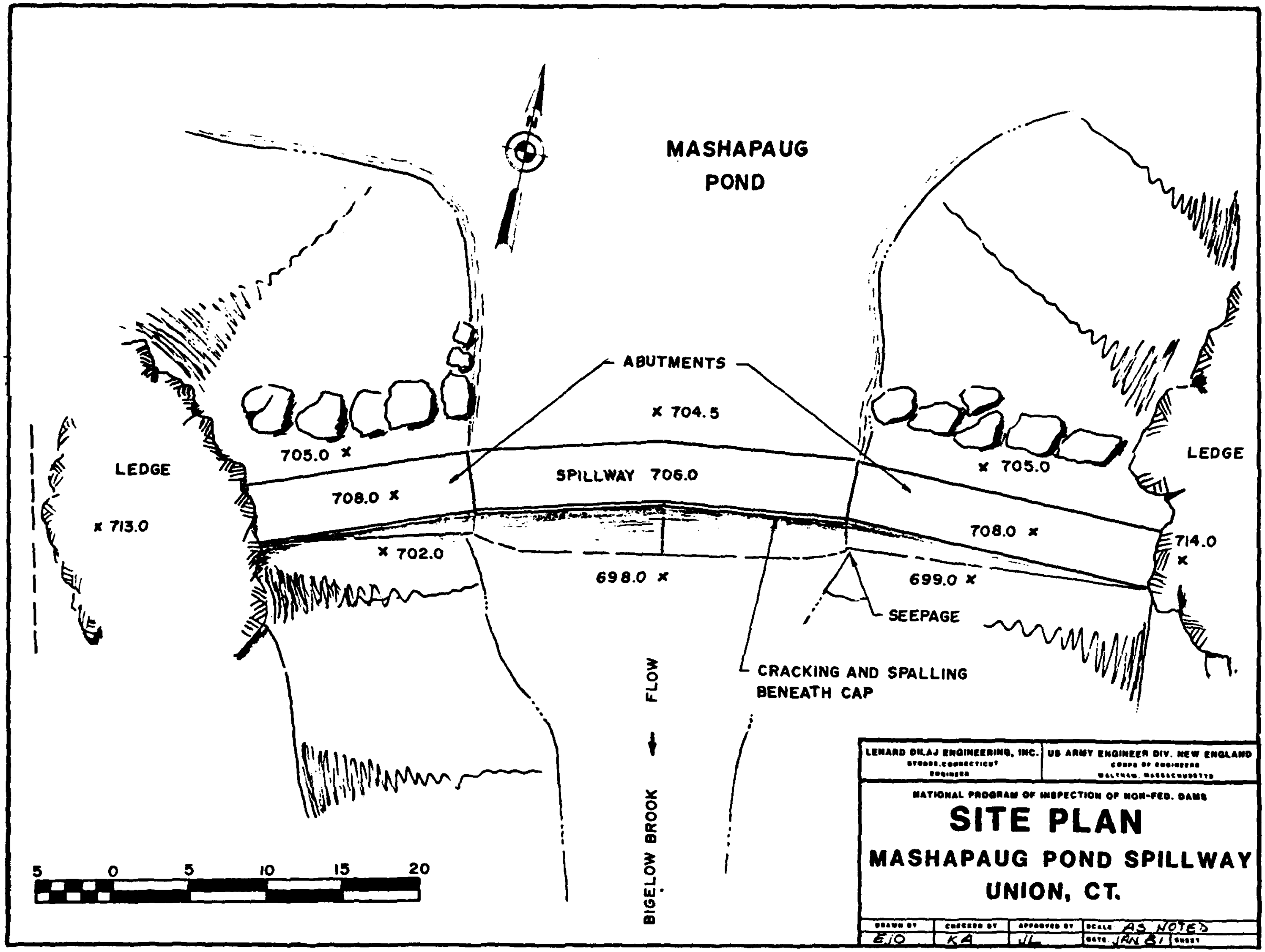
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

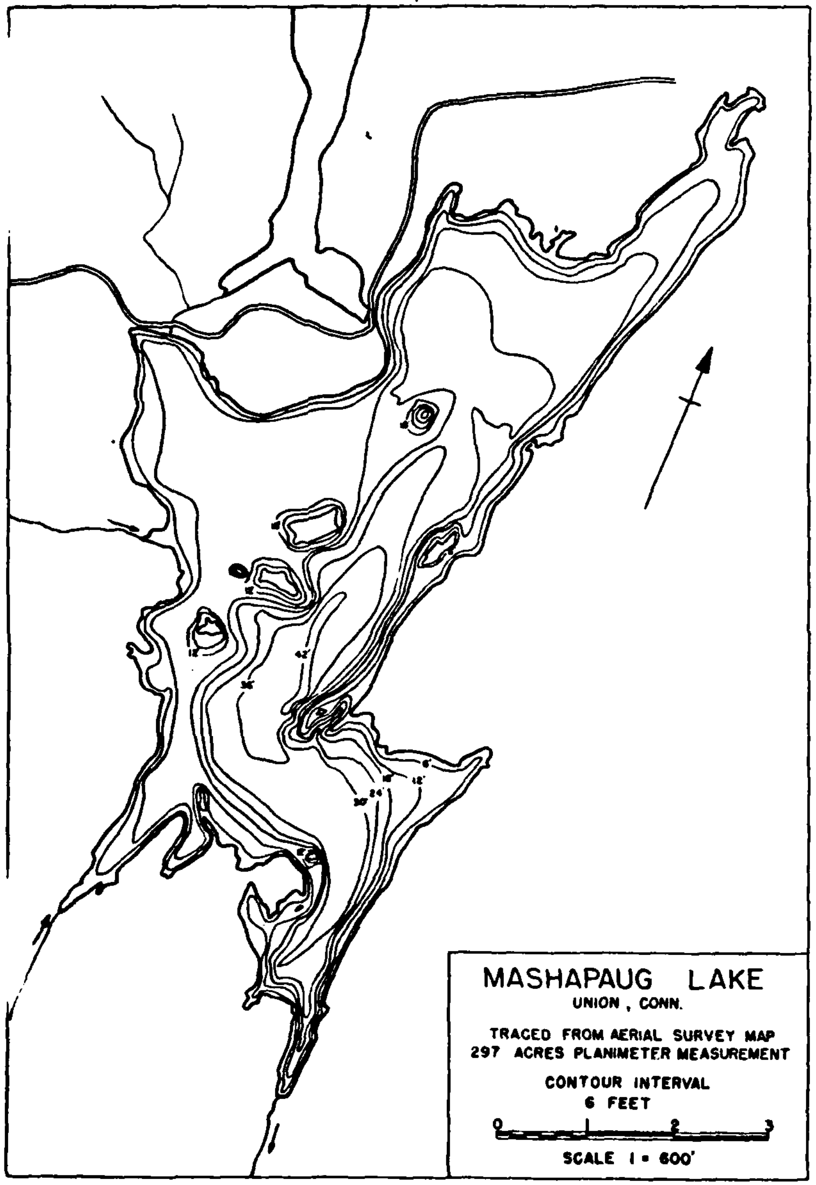
SITE PLAN

MASHAPAUG POND DIKE

UNION, CT. 3

DRAWN BY	CHECKED BY	APPROVED BY	SCALE
			DATE / SHEET


MASHAPAUG
POND
ABUTMENTS
x 704.5
705.0 x
LEDGE
x 713.0
708.0 x
SPILLWAY 706.0
x 705.0
LEDGE
708.0 x
714.0
x
x 702.0
698.0 x
699.0 x
SEEPAGE
CRACKING AND SPALLING
BENEATH CAP
FLOW
BIGELOW BROOK
5 0 5 10 15 20
LENARD DILAJ ENGINEERING, INC.
US ARMY ENGINEER DIV. NEW ENGLAND
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
SITE PLAN
MASHAPAUG POND SPILLWAY
UNION, CT.
AS NOTED



MASHAPAUG LAKE
UNION, CONN.
TRACED FROM AERIAL SURVEY MAP
297 ACRES PLANIMETER MEASUREMENT
CONTOUR INTERVAL
6 FEET
0 1 2 3
SCALE 1 = 600'

Mashapaug Lake

Mashapaug Lake is natural in origin with the level raised approximately 8 feet by the construction of an earthen dam across the outlet. It is located in the township of Union in Tolland County. This lake has a surface area of 297.1 acres, a maximum depth of 43 feet and an average depth of 9.2 feet. As in most large lakes, the bottom is variable. In the shallows, the bottom is mostly of sand, gravel, rubble, boulders and ledge. In the deeper waters, there are considerable areas where the bottom is of swampy ooze. Submerged and emergent vegetation is relatively scarce except in some scattered, shallow areas where it is fairly abundant. The surrounding countryside is mostly hilly and wooded. Water from this lake is used for industrial purposes and, as a result, the water level is subject to considerable fluctuation. The lake is thermally stratified and the waters to a depth of 30 feet are well supplied with dissolved oxygen. An oxygen deficiency exists at depths greater than 30 feet. The water is clear and transparency exceeds 15 feet.

Access to Mashapaug Lake is provided through a state-owned right-of-way, boat launching area and parking area in the Bigelow Hollow State Park at the southern end of the lake. Picnic facilities are available in the state park. Shoreline development is very light and there are very few cottages on the lake. Outboard motor size is limited to 5 horsepower.

Mashapaug Lake has been stocked with smallmouth bass, landlocked salmon, calico bass, yellow perch, chain pickerel, bullheads, sunfish, golden shiners, brown trout, rainbow trout and brook trout.

Largemouth bass and chain pickerel are common in abundance and exhibit above-average growth rates. Smallmouth bass are present, but scarce. The growth rate of this species was not determined.

Yellow perch are common in abundance and grow at a rate equal to the state average. Bluegill sunfish and common sunfish are common in abundance in the shoal areas; elsewhere in the lake these fish are scarce. Calico bass are scarce and grow at a rate equal to the state average. Golden shiners are present, but scarce. Brown trout are common in the age class stocked; older, holdover fish are scarce. This lake should furnish excellent fishing for largemouth bass, chain pickerel and yellow perch.

This body of water is in a good state of balance. No special regulations or special management practices are needed at this time.

HISTORY OF MASHAPAUG POND DAM

The first mill built in the vicinity of Mashapaug Pond was located near what is now Lower Mashapaug Pond (and formerly The Mill Pond). It was built by Captain Daniel Badger (a Revolutionary War hero) around 1740, and later burned in 1825 under the ownership of Philip Corbin and Robert and Paul Lawson. Indications are that the facilities for Mashapaug Pond (the Upper Mashapaug Pond) were constructed sometime in the period between 1740 and 1846, when records indicate that Josiah Leland purchased land in the vicinity of Mashapaug Pond from the Quinebaug Reservoir Company. Flow rights were, however, retained by the Quinebaug Reservoir Company for the use of downstream factories and mills. The company also retained the right to raise the dams and water level at the pond, to maintain its existing facilities and to excavate materials required for the construction of dams and appurtenant facilities.

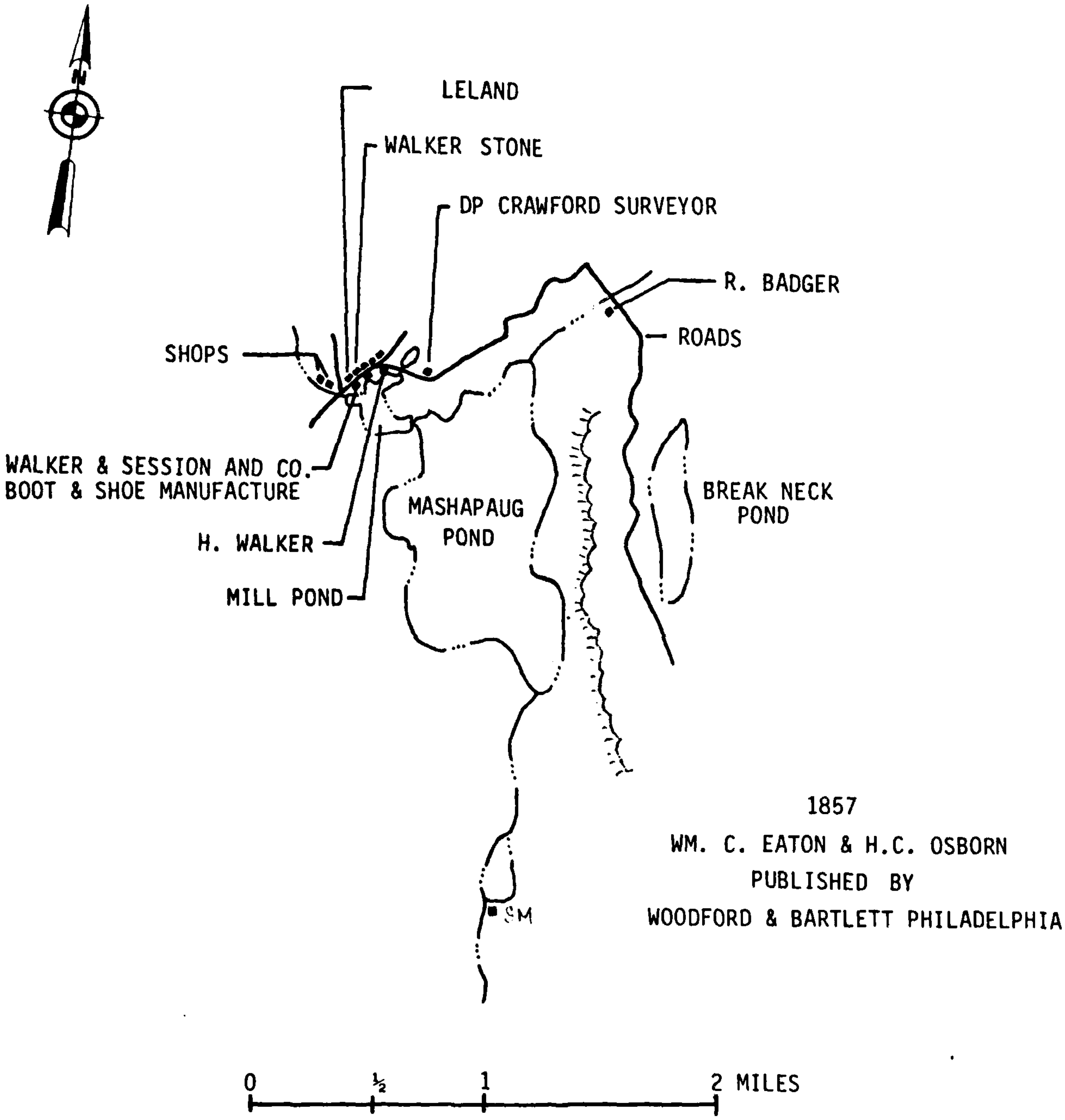
In 1899, the structures at Mashapaug Pond, and subsequently the water level, were raised to what is considered to be their present elevation. Flow rights at that time were owned by the Hamilton Woolen Company. After construction was completed, an inspection was conducted by T.H. McKenny as indicated by the following certification recorded on December 18, 1900: "This certifies that I have inspected the plans, specifications and workmanship of the dams which have been built by the Hamilton Woolen Co., or the Quinebaug Reservoir Co., for the purposes of raising the levels of Mashapaug Lake in the Town of Union, Connecticut, and I hereby approve the same. I believe them to be sufficient to withstand the action of water under any circumstance which may be reasonably expected to occur." Mr. McKenny was a member of the Connecticut State Board of Civil Engineers.

Land owned by the Reservoir Company, or subsequent owners, around the perimeter of the pond was later acquired by the State of Connecticut for purposes of creating a park and a state forest conservation area.

The order of ownership from 1846 is as follows:

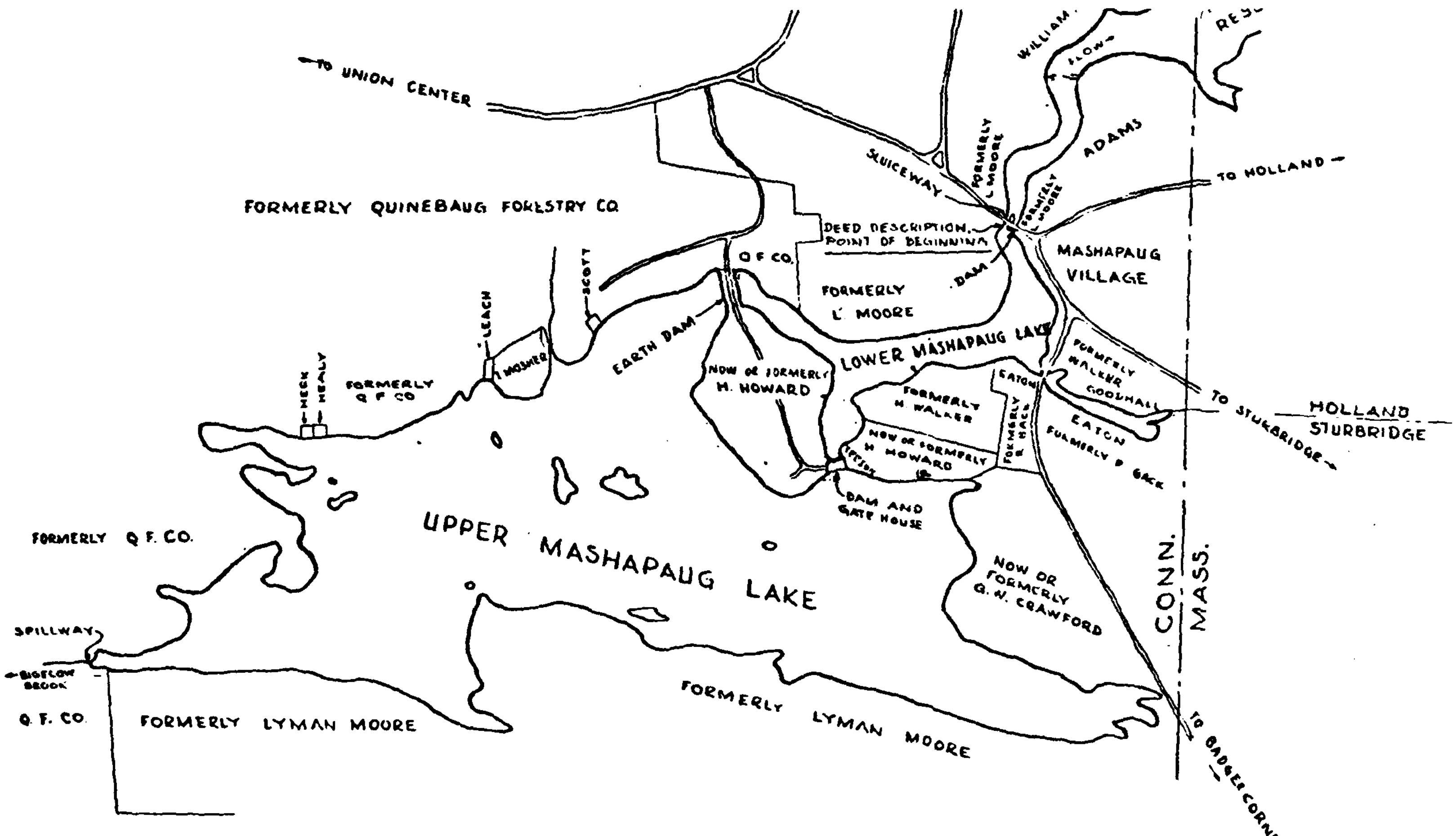
1846-1928	Quinebaug Reservoir Company
1928-1935	Hamilton Woolen Company
1935-1956	Ames Textile Corporation
1956-present	American Optical Company

The American Optical Company only owns and maintains the dam, dike and spillway at the present time, all other land having been granted to the State of Connecticut.



MAP 1

TRACING OF OLD PLAN



NOTE
TRACED FROM PLAN DATED MARCH, 1921
AND REVISED FOR RECORDING WITH DEED
(OCT. 10, 1956 N.L. Leathers, Eng'r)

MAP OF MASHAPAUG VILLAGE
AREA IN UNION, CONN

FILED WITH BM. 3017

RECEIVED

NOV 25 1955

STATE WATER COMMISSION

November 22, 1955

Mr. Chester Martin
Old Lyme, Connecticut

Dear Sir:-

On November 21, 1955 I visited with you the Mashapaug Ponds - both upper and lower. These ponds are located in the Town of Union almost at the dividing line between Connecticut and Massachusetts.

The spillway for the Lower Pond is located just West of the South bound roadway of the Wilbur Cross Parkway. The water from this pond crosses under the highway through a culvert 20 feet wide and about 4 feet deep beneath the bottom of the bridge girders. There is a dam a few feet West of the bridge and this is a stone dam with a concrete apron on top. The drainage area of this Lower Pond is about 4 square miles and it is my opinion that the water passage under the parkway is not adequate for maximum floods. I believe that during the past storms of August and September that the water came over the parkway for a short time. It would be a major expense to increase the width of the bridge at this parkway and I do not think that it is necessary to do so. The water would only go over the roadway during emergency conditions and I think that conditions better be left as they are.

The dam itself seems to be in fairly good condition, although some of the planking on the side of the drawdown gate would need to be replaced in time. It is not in a bad condition, however. I do not think that the State would be put to any serious expense in the near future in maintaining this dam.

There is an earth dike, which is perhaps 250 feet long and it separates the Lower Pond from the Upper Pond. I would assume that the difference in water level between the Upper and Lower Ponds is perhaps 11 feet. There is a gate to allow the water to come from the Upper to the Lower Pond but there is not any spillway in this embankment other than the gate. So far as I could tell the embankment appeared to be in good condition and I did not see any excessive leaks.

The gate appeared to be all right, although I could not examine it in detail. I do not think that there is any serious maintenance problem on this dike.

There is a second dike along the edge of the Upper Pond and this I would estimate is 600 or 700 feet long. It has some stone rip rap on the water side and it is rather swampy on the low side. This dike appears to have been made of gravel without much clay and it may be rather porous but the leaks, if any, did not seem to be dangerous or excessive. Some work should be done on this dike in the way of cutting down trees and brush which have grown up. A few loads of fill should be placed on the upstream side where the embankment has eroded away. The total expended on this dike I think would not exceed $1,000 and does not constitute any emergency but does represent some maintenance work that should be done.

The spillway for the Upper Pond is at the opposite end of the Lake from the Lower Pond. This spillway has a small concrete wall about 21 feet long and 2 feet deep. However, there is a concrete extension on either side of 20 feet of wall and then natural ledge running up the sides from this point, so that in effect the spillway is about 61 feet long and water could flow over it at least 2 feet deep on the shallow part and 4 feet deep on the deep part without causing any washout. The drainage area to the Upper Pond is only about three square miles, although the pond itself is much larger than the Lower Pond. I consider this spillway to be adequate for the location and the conditions surrounding it. Some question was raised about keeping the level of the water in the Upper Pond 2 or 3 feet lower than full pond. This is, of course, a matter for the Department to decide but I do not think it is necessary as far as the safety is concerned. I do not think that it would be necessary for the State to spend any money on the spillway as above described.

My conclusion is that if the State decides to take over these two ponds that the expense involved would be small to bring them up to condition.

Very truly yours,

B H Palmer.

Member, State Board for Supervision of Da

BHP/ew
c.c.: Chairman Wm. S. Wise

STATE OF CONNECTICUT

DEPARTMENT OF ENVIRONMENTAL PROTECTION
STATE OFFICE BUILDING • HARTFORD, CONNECTICUT 06115

20 June 1974

Mr. James A. Thompson
Buck and Buck Engineers
98 Wadsworth Street
Hartford, CT 06106

Re: Upper Mashapaug Lake Dams
Union

Dear Jim:

Under the terms of your contract to act as a consultant to this department, will you please inspect and submit a report on the condition of the subject dams. Also, submit a cost estimate for any necessary repairs.

Very truly yours,

Victor F. Galgowski
Supt. of Dam Maintenance
Water & Related Resources
Telephone no. 566-5506

VFG:ljg

BUCK & BUCK

ENGINEERS

98 WADSWORTH STREET, HARTFORD, CONNECTICUT 06106

JAMES A. THOMPSON
ROBINSON W. BUCK
LAWRENCE F. BUCK

HENRY WOLCOTT BUCK
1931-1965
ROBINSON D. BUCK
1935-1959

COMM. 5713-98

November 27, 1974

WATER & RELATED
RESOURCES
RECEIVED

ANSWERED ______

______

FILED ______

Mr. Victor Galgowski,
Water and Related Resources,
State Office Building,
Capitol Avenue,
Hartford, Connecticut 06103

Re: Mashapaug Pond

Dear Vic:

In accordance with your request we have inspected the spillway and two dams at the subject pond and have analysed its capacity. We have the following to report:

<u>Spillway, South End of Pond</u>

The spillway is 25 feet long with an available water height of two feet. It is founded on ledge rock and is in good condition. Above the two foot level the waterway widens to 40 to 50 feet and is concrete to ledge rock. There was some flow downstream of the spillway but we feel this flow is through fissures in the ledge and is of no concern. The spillway has a capacity of 233 cubic feet per second with a headwater depth of 2.0 feet.

Our hydrologic analysis revealed the following:

Watershed Area	2,982 Acres
Pond Surface	272 Acres
Peak Inflow from 100 year storm:	
1 day duration	1,765 cfs
2 day duration	1,302 cfs
10 day duration	385 cfs
Peak Outflow from 100 year storm:	
1 day duration	254 cfs
2 day duration	259 cfs
10 day duration	158 cfs

At the peak outflow of 259 cfs, the depth of flow over the sides of the spillway section will be about one inch, and the velocity will be about 1.6 feet per second, or less than half of the minimum eroding velocity of four feet per second.

We conclude that the South spillway of Mashapaug Pond is in satisfactory condition and has adequate capacity. A copy of our calculations is enclosed.

Northerly Dam with Outlet Gate

This dam is an earth embankment with no overflow spillway. It has a locked gate which has some type of discharge control. To inspect this control, it will be necessary to obtain permission and keys from the owner.

The upstream face of the dam is protected with field stone rip-rap to approximately 3 feet above normal water surface. There are many trees on both the upstream and downstream face of the dam. These trees should be removed.

The outlet to the gate, on the downstream slope of the dam, was below water and therefore could not be inspected. The downstream face of the dam, in the area of the outlet, consists of Heavy Masonry (rubblestone and concrete) retaining walls. These walls have been severely eroded and show deep penetration in some areas. These walls should be repaired by removing the loose material, and forming and pouring a new concrete surface.

We found a 5 gpm seep at the toe of the embankment adjacent to the North abutment. We also found considerable flow at the toe of the slope, South of the outlet structure. This second flow could not be measured because of the swampy condition of the area. Both these seeps could probably be corrected with additional downstream fill. The existing downstream slope of the dam appears to be approximately 1 1/2:1. According to current standards this slope should be no more than 3:1.

North Westerly Dam

This dam is an earthen (sand) embankment with steep (1 1/2:1) upstream and downstream slopes. There is serious erosion on the upstream slope due to foot traffic. There has been some attempt to correct this erosion by adding rip-rap, but the job is far from complete.

Both faces of the dam are overgrown and should be cleaned of trees and brush. We also noted some seepage at the toe of the downstream slope near the East abutment, but it did not appear to be serious. The principle problem with this dam is the erosion due to foot traffic of people.

Sincerely,

BUCK & BUCK

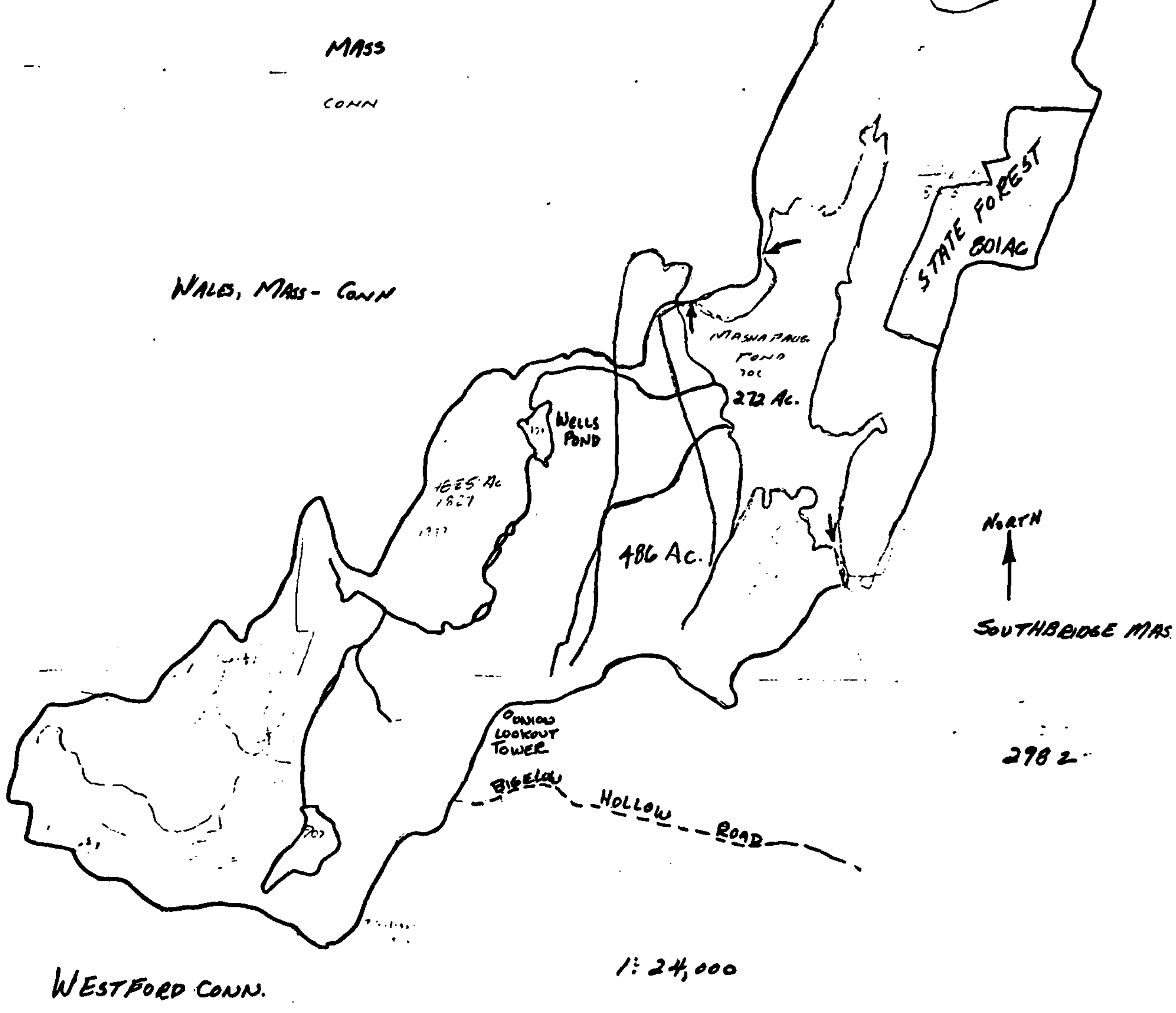
James A. Thompson

JAT:fb
Enc.

COM. ________ BUCK & BUCK ENGINEERS COMM. NO. 713 N

CHECKED BY ________ DATE 11-22-74

APPROVED BY ________ JOB MASHAPAUG POND SHEET NO. 1 OF 12



GENERAL COMPUTATION SHEET

BUCK & BUCK
ENGINEERS

COMPUTED BY LBS
CHECKED BY
APPROVED BY
JOB MASHAPAUG POND

COMM. NO. 5713-28
DATE 11-22-74
SHEET NO. 2 OF 12

Principal Soil Types

		Class	
Cr	Charlton	B	
Hk	Hinkley	A	
Pe	Paxton	C	USE CLASS B
Bp	Brimfield	C/D	
Pb	Paxton	C	

STATE FOREST AREA 801 Ac.

ASSUME: SOIL GROUP B
MODERATELY COMPACT HUMUS
3" HUMUS

FROM FIG 9.1, HYDROLOGIC COND'N CLASS = 3.2

FROM FIG 9.2 CN = 62

WATER SURFACE
MASHAPAUG POND 272 Ac.
OTHERS 28 ±
300 Ac.

CN = 100

REMAINDER: ASSUME HALF OF AREA WILL REMAIN UNDEVELOPED, HALF WILL BE 1 Ac. LOTS

TOTAL AREA = 2982 Ac.
Less S.F. & W 1101
1881 Ac 940 WOODS/OPEN.

941 DEVELOPED:
94 Ac PVT = 95
60 Ac ROOF = 95
1000 Ac. LAWN = 58

GENERAL COMPUTATION SHEET

BUCK & BUCK
ENGINEERS

COMPUTED BY K.S.S. — COMM. NO. 5717-73
CHECKED BY ______ — DATE 11-25-74
APPROVED BY ______ JOB Massquahaug Pond — SHEET NO. 3 OF 12

WEIGHTED CURVE NO.

801	×	62	=	49662
300	×	100	=	30000
940	×	62	=	58280
94	×	95	=	8930
60	×	95	=	5700
600	×	58	=	34800
187	×	62	=	11594
2982				198966

66.7 SAY 67

TIME OF CONCENTRATION

Main Brook Length = 10.5" = 21,000 l.f.
Allow 20 min Overland flow to headwater
Drop in Main Brook = 1190-706 = 484
S = .023

ASSUME MANNINGS n = .040

TRY R = 1, 3, 5, 7
Then v = 5.6, 11.6, 16.5

Use $v = 7\ ft/sec.$, then $t_c = 20 + \frac{21,000}{7 \times 60} = 70\ min$

SAY 1.2 HRS

$T_p = 0.7\ T_c = 0.84$ HRS

COMPUTED BY J.B.S.

CHECKED BY

APPROVED BY

GENERAL COMPUTATION SHEET

BUCK & BUCK
ENGINEERS

JOB MASHAPAUG POND

COMM. NO. 5713-78

DATE 11-25-74

SHEET NO. 4 OF 12

GENERATE FLOOD HYDROGRAPHS FOR 100 YEAR STORMS OF 24HR 48HR & 10DAY

FOR 10DAY STORM, CN IS DECREASED ACCORDING TO TABLE 21.2

USE 10 DAY CN = ~~48~~ 50

1 DAY P: 6.9" Q=3.22"

2 DAY P: 9" Q=4.5"

10 DAY P: 13.2" Q=6"

RUNOFF Q FROM FIG 10.1

$P=6.9$ $CN=67$ $P^* = .98$ $.98/6.9 = .142$

$T_0 = .744 \times 24 = 17.8$ HRS

$P=9"$ $CN=67$ $P^* = .98$ $.98/9 = .109$

$T_0 = .789 \times 48 = 37.9$ HRS

$P=13.2$ $CN=50$ $P^* = 2.00$ $2.00/13.2 = .152$

$T_0 = .735 \times 240 = 176$ HRS

HYDROGRAPH COMPUTATION

BUCK & BUCK
ENGINEERS

COMPUTED BY P.H.B COMM. NO. 5713-98
CHECKED BY DATE 11-26-74
APPROVED BY SHEET NO. 5 OF 12

JOB 100 YR 1 DAY

STRUCTURE SITE OR SUBAREA MASHAPAUG POND

DR. AREA 4.66 SQ. MI. T_c 1.2 HR. RUNOFF CONDITION NO. II

RUNOFF CURVE NO. 67 STORM DISTRIB. CURVE B HYDROGRAPH FAMILY NO. 3

STORM DURATION 24 HR. RAINFALL: 6.9 POINT 6.9 IN. AREAL 6.9 IN.

Q 3.22 IN. COMPUTED T_p ___ HR. 0.84 T_o 17.8 HR.

$(T_o + T_p)$: COMPUTED 21.1; USED 25 REVISED T_p .712

$q_p = \frac{484\ A}{\text{REV. } T_p}$ = 3168 CFS. Qq_p = 10,200 CFS.

t(COLUMN) = (t/T_p) REV. T_p. q(COLUMN) = (q_c/q_p) Qq_p.

LINE NO.	t HOURS	q CFS	LINE NO.	t HOURS	q CFS	LINE NO.	t HOURS	q CFS
1	0	0	21	17.52	316	41		
2	.88	20	22	~~17~~ 18.39	255	42		
3	1.75	92	23	19.27	41	43		
4	2.63	745	24	20.14	10	44		
5	3.50	1765	25	21.02	0	45		
6	4.38	1346	26			46		
7	5.25	979	27			47		
8	6.13	775	28			48		
9	7.00	653	29			49		
10	7.88	561	30			50		
11	8.76	510	31			51		
12	9.63	469	32			52		
13	10.51	428	33			53		
14	11.38	388	34			54		
15	12.26	357	35			55		
16	13.14	337	36			56		
17	14.01	326	37			57		
18	14.89	316	38			58		
19	15.76	316	39			59		
20	[illegible]	[illegible]						

HYDROGRAPH COMPUTATION

BUCK & BUCK
ENGINEERS

COMPUTED BY [illegible]
CHECKED BY
APPROVED BY

COMM. NO. 573-98
DATE 11-25-74
SHEET NO. 6 OF 14

JOB 100 YR 2 DAY

STRUCTURE SITE OR SUBAREA MASHAPAUG POND

DR. AREA 4.66 SQ. MI. T_c 1.2 HR. RUNOFF CONDITION NO. II

RUNOFF CURVE NO. 67 . STORM DISTRIB. CURVE B . HYDROGRAPH FAMILY NO. 3

STORM DURATION 48 HR. RAINFALL: POINT 9 IN. AREAL 9 IN.

Q 4.5 IN. COMPUTED T_p ___ HR. .84 T_o 32.9 HR.

$(T_o + T_p)$: COMPUTED 45 ; USED 50 . REVISED T_p .758

$q_p = \frac{484\ A}{\text{REV. } T_p}$ = 2975 CFS. Qq_p = 13,400 CFS.

t(COLUMN) = (t/T_p) REV. T_p. q(COLUMN) = (q_c/q_p) Qq_p.

LINE NO.	t HOURS	q CFS	LINE NO.	t HOURS	q CFS	LINE NO.	t HOURS	q CFS
1	0	0	21	34.11	205	41		
2	1.71	1	22	35.81	201	42		
3	3.41	94	23	37.52	197	43		
4	5.12	635	24	39.22	37	44		
5	6.82	1302	25	40.93	0	45		
6	8.53	860	26			46		
7	10.23	616	27			47		
8	11.94	503	28			48		
9	13.64	431	29			49		
10	15.35	382	30			50		
11	17.05	346	31			51		
12	18.76	320	32			52		
13	20.47	293	33			53		
14	22.17	269	34			54		
15	23.88	248	35			55		
16	25.58	232	36			56		
17	27.29	221	37			57		
18	28.99	217	38			58		
19	30.70	213	39			59		
[illegible]	[illegible]	[illegible]						

HYDROGRAPH COMPUTATION

COMPUTED BY L&B3 COMM. NO 5713-98

CHECKED BY ______ **BUCK & BUCK** ENGINEERS DATE 11-25-74

APPROVED BY ______ SHEET NO. 7 OF 12

JOB 100 YR 10 DAY

STRUCTURE SITE OR SUBAREA Mashapaug Pond

DR AREA 4.66 SQ. MI. T_c 1.2 HR. RUNOFF CONDITION NO. II

RUNOFF CURVE NO. 50 . STORM DISTRIB. CURVE B . HYDROGRAPH FAMILY NO. 3

STORM DURATION 240 HR. RAINFALL: POINT 13.2 IN. AREAL 13.2 IN.

Q 6 IN. COMPUTED T_p .84 HR. ______ T_o 176 HR.

$(T_o + T_p)$: COMPUTED 200 ; USED 75 . REVISED T_p 2.35

$q_p = \frac{484\ A}{REV.\ T_p}$ = 961 CFS. Qq_p = 5768 CFS.

t(COLUMN) = (t/T_p) REV. T_p. q(COLUMN) = (q_c/q_p) Qq_p.

LINE NO.	t HOURS	q CFS	LINE NO.	t HOURS	q CFS	LINE NO.	t HOURS	q CFS
1	0	0	21	153	59	41		
2	8	5	22	160	58	42		
3	15	33	23	168	57	43		
4	23	167	24	176	56	44		
5	31	385	25	183	2	45		
6	38	257	26	191	0	46		
7	46	183	27			47		
8	53	148	28			48		
9	61	126	29			49		
10	69	112	30			50		
11	76	102	31			51		
12	84	92	32			52		
13	92	85	33			53		
14	99	78	34			54		
15	107	73	35			55		
16	115	68	36			56		
17	122	65	37			57		
18	130	63	38			58		
19	137	62	39			59		
20	145	61						

FLOOD ROUTING

STORAGE DISCHARGE RELATION:
ASSUME VERTICAL BANKS

SPILLWAY $L = 25'$, $H_{max} = 2'$
OVER SPILLWAY ADD'L $L = 15'$

$$S = 43560 \times 272 \times H = 11,848,320\ H$$

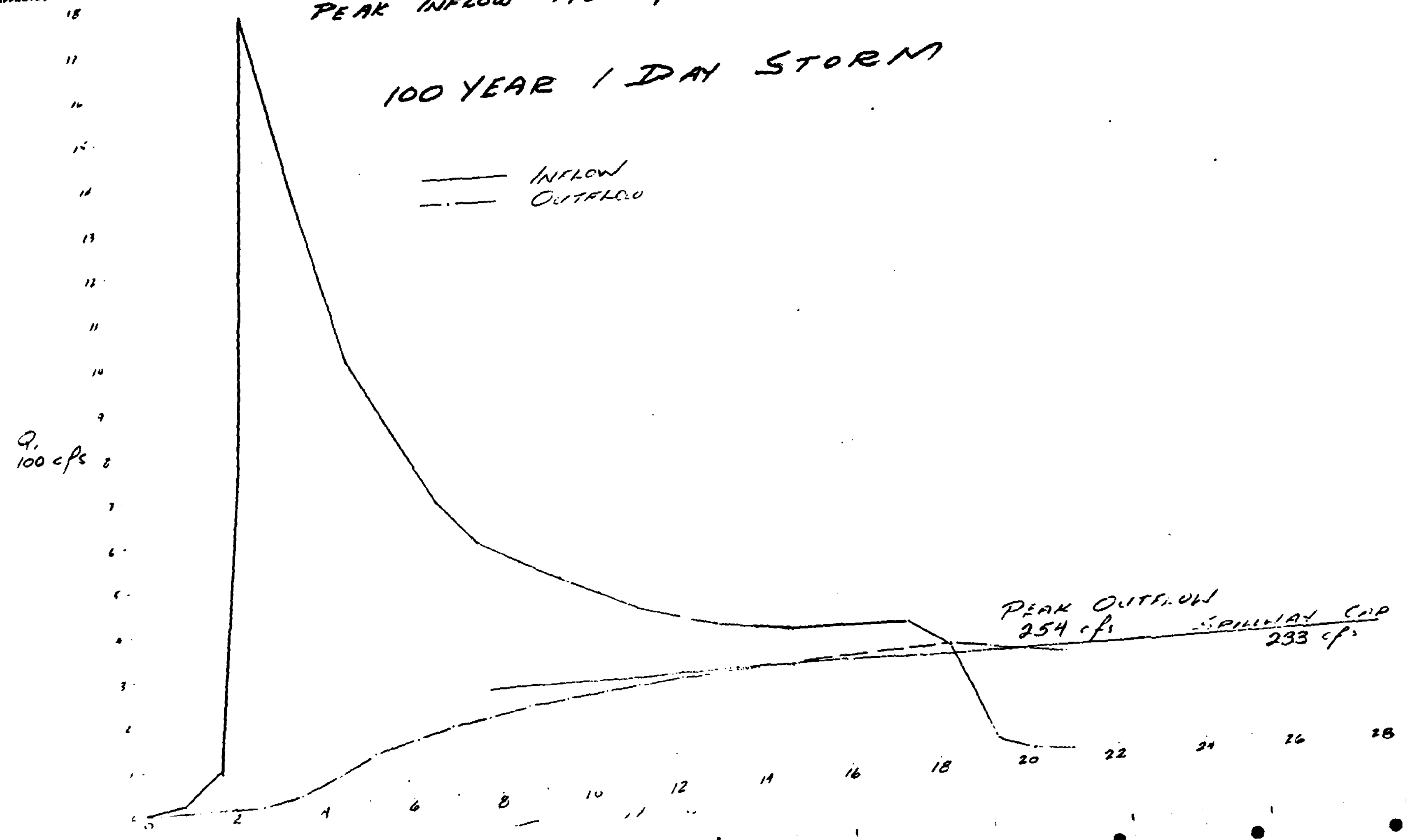
$$Q = 3.3 \times 25 \times H^{3/2} = 82.5\ H^{3/2}$$

H	S	Q_s	Q_{os}	ΣQ
0.2	2,369,664	7.38		
0.4	4,739,328	20.87		
0.6	7,108,992	38.34		
0.8	9,478,656	59.03		
1.0	11,848,320	82.50		
1.2	14,217,984	108.45		
1.4	16,587,648	136.66		
1.6	18,957,312	166.97		
1.8	21,326,976	199.23		
2.0	23,696,640	233.35		
2.2	26,066,304	269.21	7.38	276.59
2.4	28,435,968	306.74	12.52	319.26
2.6	30,805,632	345.87	23.00	368.87
2.8	33,175,296	386.54	35.42	421.96
3.0	35,544,960	428.68	49.5	478.18

GENERAL COMPUTATION SHEET
BUCK & BUCK
ENGINEERS

COMPUTED BY ____
CHECKED BY ____
APPROVED BY ____
JOB Mehapik Pond

COMM. NO. [illegible]
DATE 11-16-2[illegible]
SHEET NO. 9 OF 12



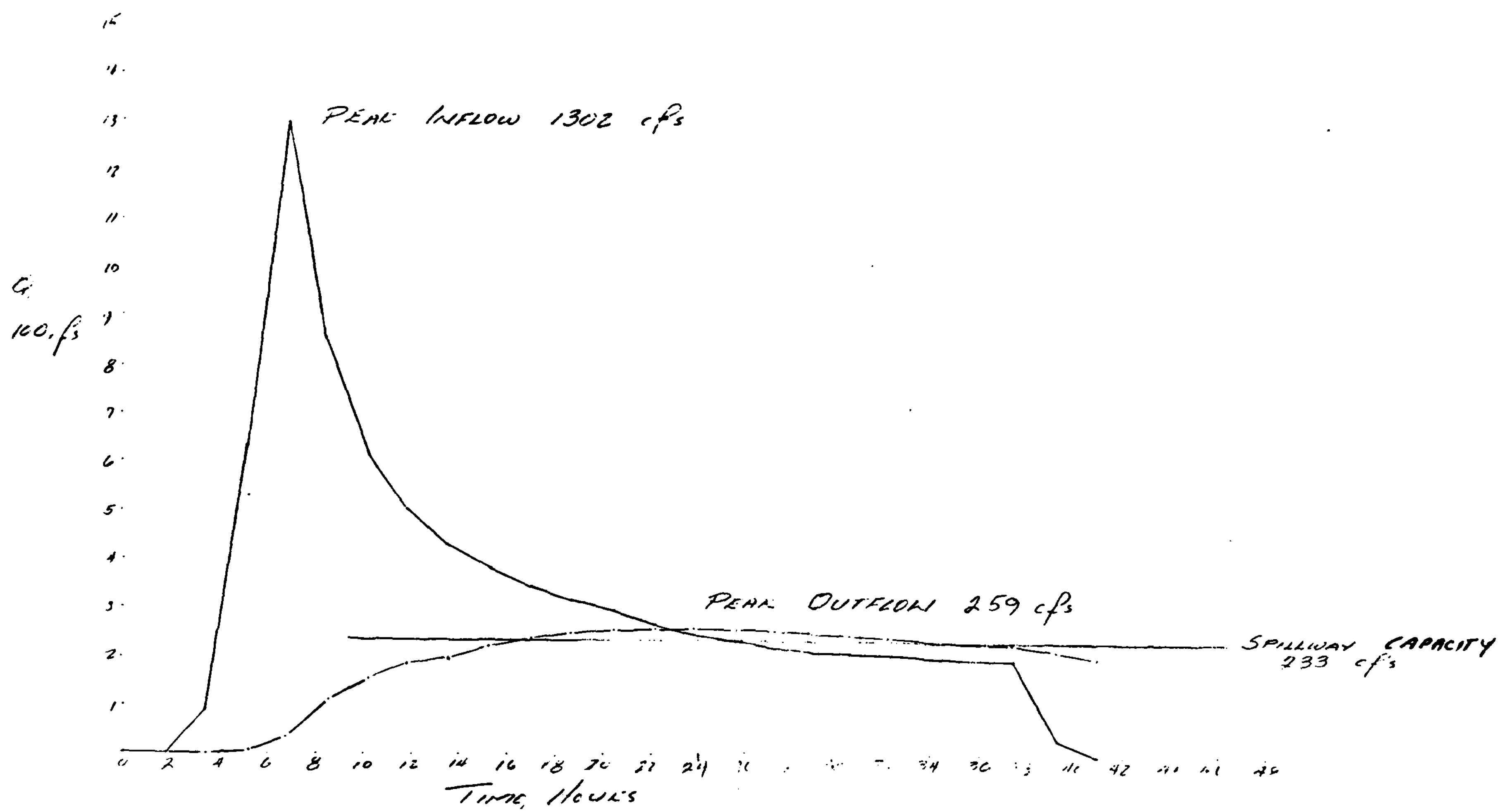
COMPUTED BY ___
CHECKED BY ___
APPROVED BY ___

BUCK & BUCK
ENGINEERS

JOB Massapoag Pond

COMM. NO. ___
DATE 2-26-79
SHEET NO. 10 OF 12

100 YEAR 2 DAY STORM



COMPUTED BY [illegible]

CHECKED BY

APPROVED BY

GENERAL COMPUTATION SHEET

BUCK & BUCK
ENGINEERS

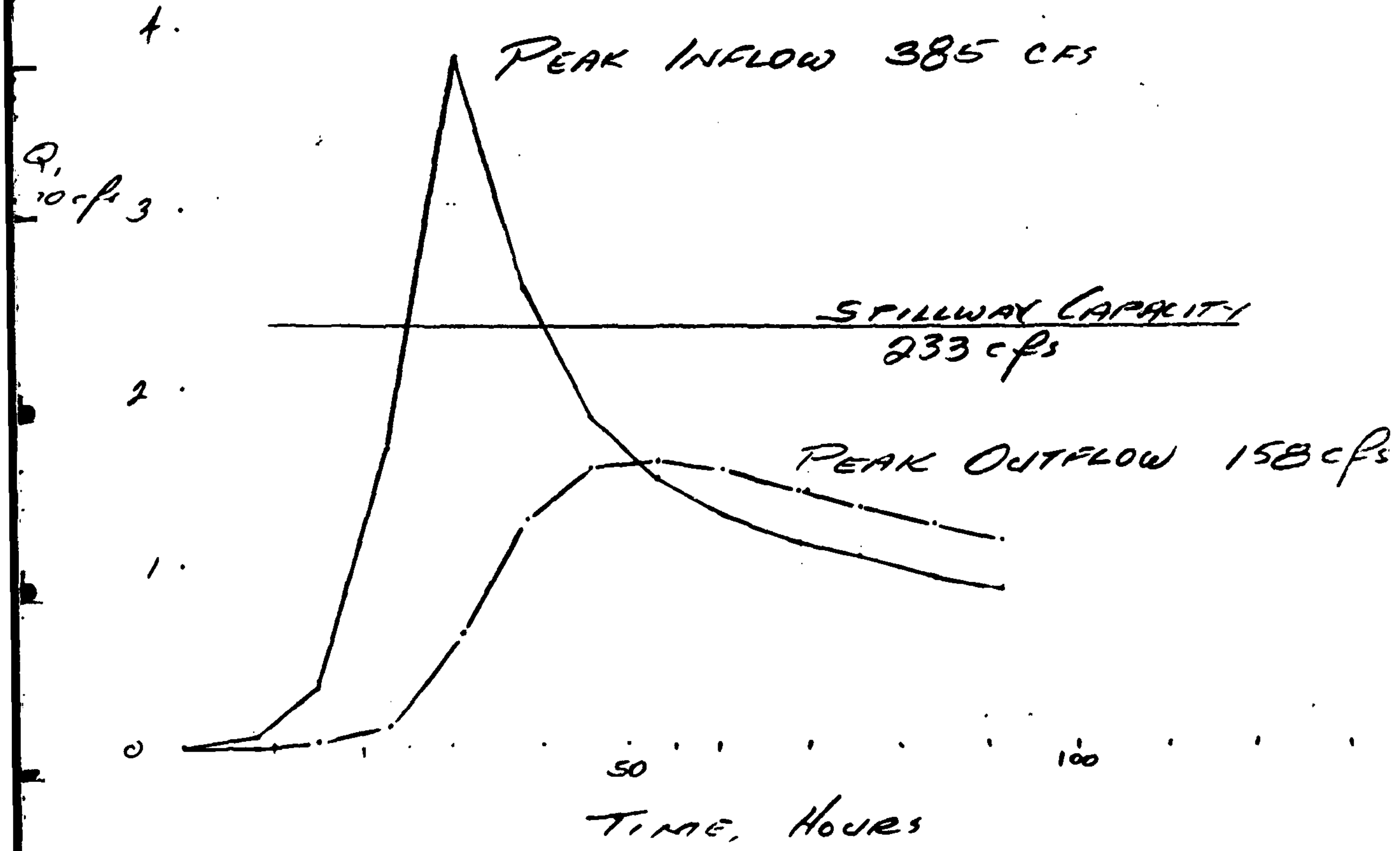
JOB MASHAPAUG POND

COMM. NO 5715

DATE 11-27-7[illegible]

SHEET NO 11 OF 11

100 YEAR 10 DAY STORM



GENERAL COMPUTATION SHEET
BUCK & BUCK
ENGINEERS

COMPUTED BY ______ COMM. NO. 5723-73
CHECKED BY ______ DATE 11/27/73
APPROVED BY ______ JOB MASHAPAUG POND SHEET NO. 12 OF 12

PEAK WATER SURFACE @ Q = 259 cfs

$$259 = 82.5\,H^{3/2} + 49.5\,(H-2)^{3/2}$$

$$= 82.5\,H^{3/2} + (H^3 - 4H^2 + 8H - 8)^{1/2} \cdot 49.5$$

$$259 = 82.5\sqrt{H^3} + 49.5\sqrt{H^3 - 4H^2 + 8H - 8}$$

$$259^2 = 82.5^2\,H^3 + 49.5^2(H^3 - 4H^2 + 8H - 8)$$

$$67081 = 6806.25\,H^3 + 2450.25\,H^3 - 9801\,H^2 + 19602\,H - 196\ldots$$

$$0 = 9256.5\,H^3 - 9801\,H^2 + 19602\,H - 86683$$

$$H = \pm 2.027 - .535i\ ;\ \underline{2.129}$$

So spillway may be overtopped By .129', or 1½ inches

American Optical Corporation SOUTHBRIDGE, MASSACHUSETTS, U.S.A 01550/(617) 765-9711

October 2, 1979

Mr. Victor Galgowski
Superintendent of Dams
Water Resources Unit
Department of Environmental
Protection
State Office Building
Hartford, CT 06115

WATER RESOURCES
UNIT
RECEIVED

OCT 5 1979

ANSWERED
REFERRED
FILED

Dear Mr. Galgowski:

Subject: Spillway at Bigelow Hollow

As we discussed on the telephone, American Optical at Southbridge, MA owns and maintains three dams at Mashapaug Lake in Union, CT. They are shown on the enclosed print BM 3017.

At dam No. 1, we operate a gate valve in an attempt to control the height of water at the lake. In the summer, the residents around the lake prefer the height to be about one foot below the spillway at Bigelow Hollow. The lower level protects erosion of the embankment. In the winter, we lower the level four to five feet below the spillway to protect the boat docks.

To help control the level of the lake one foot below the spillway at Bigelow Hollow, we would like to remove a section of the concrete cap, approximately 12" deep and 12'6" wide (enclosed print PL-7667).

If the above plan is agreeable to your office, may we have your permission to proceed.

Our plans are to complete this project before winter. If there are any questions or if more information is required, do not hesitate to call me at (617) 765-9711.

Very truly yours,
AMERICAN OPTICAL CORPORATION

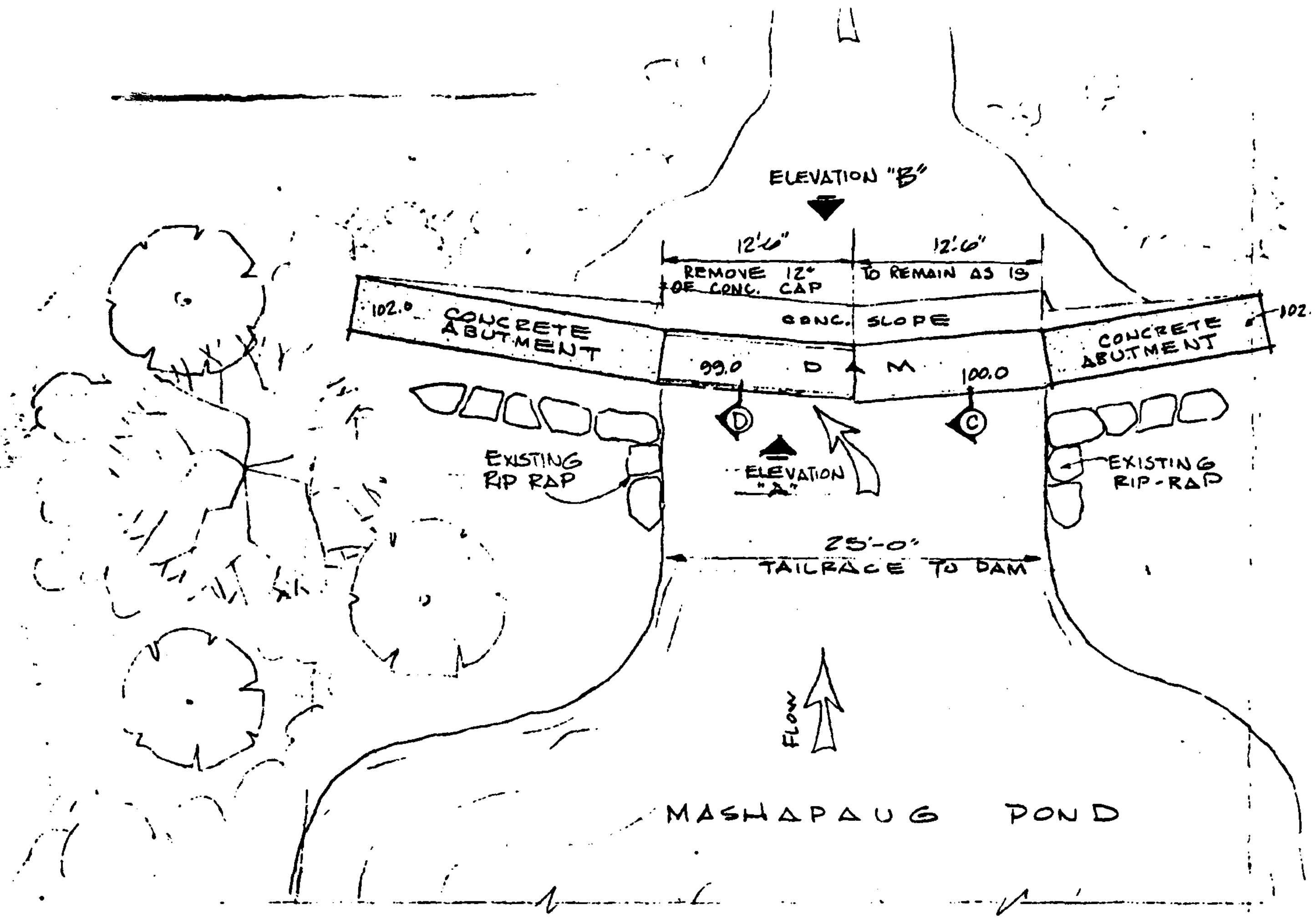
George L. Gallerani

George L. Gallerani
Director, Facilities and Security

ddr/

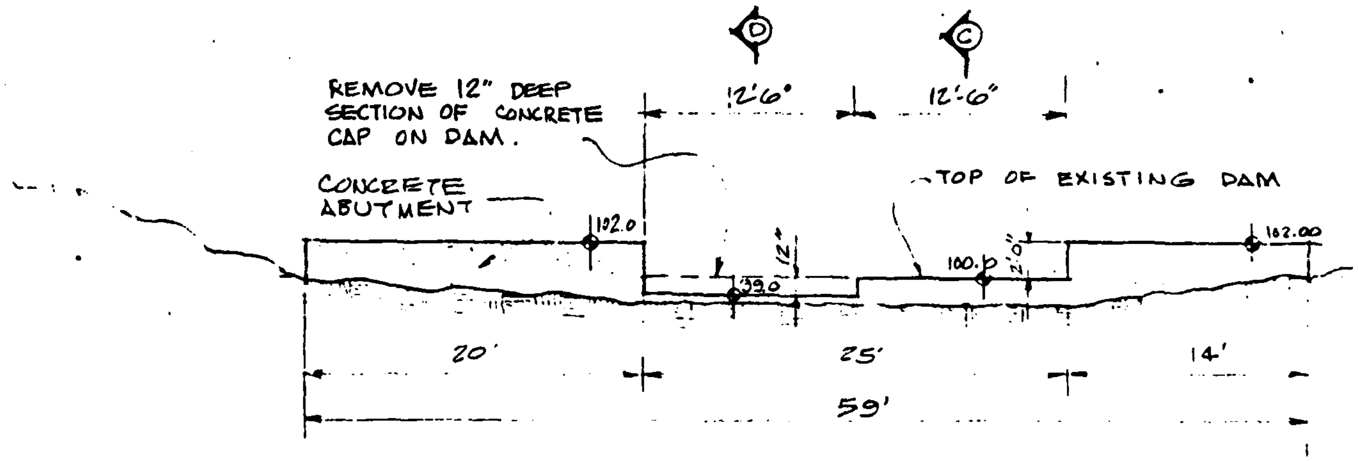
enc.

L-3A



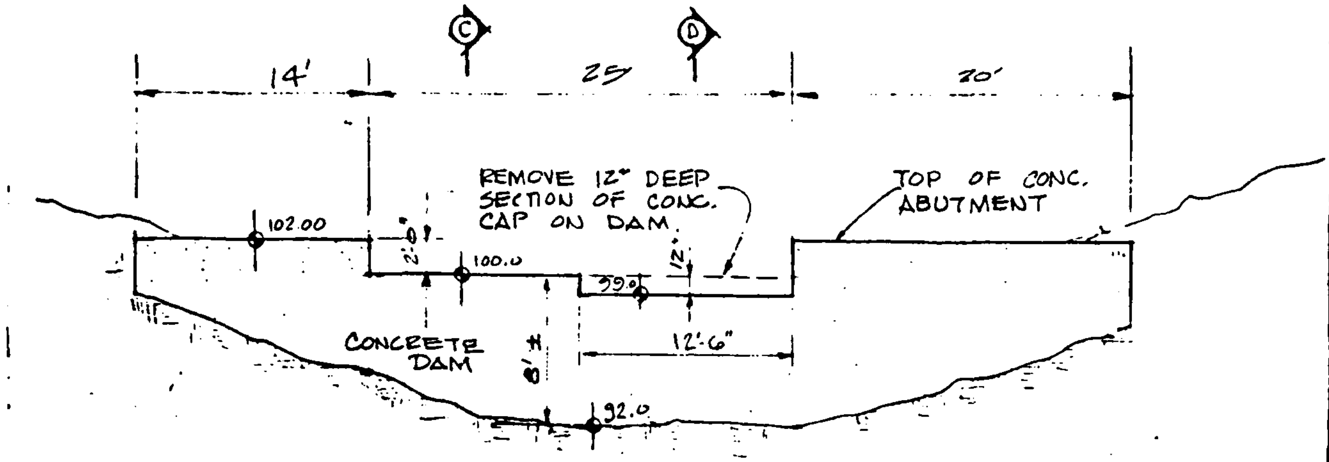
SITE PLAN

Scale 1/8"=1'0"

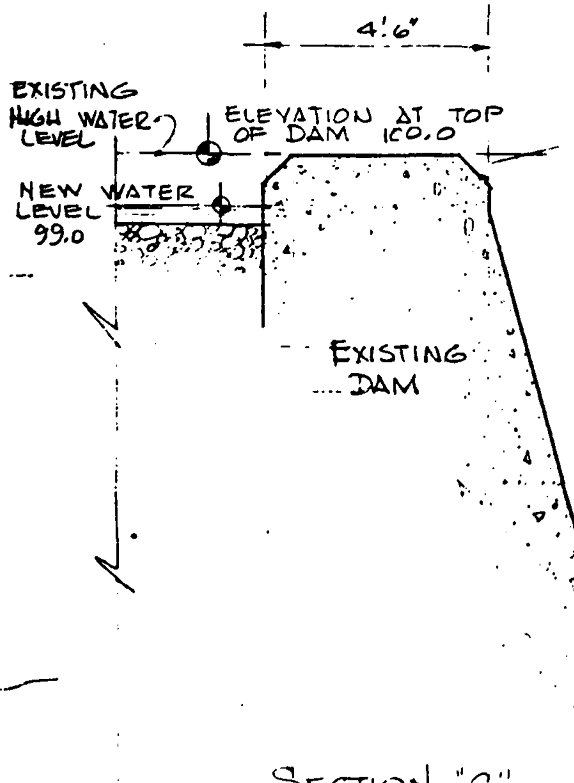


ELEVATION "A"

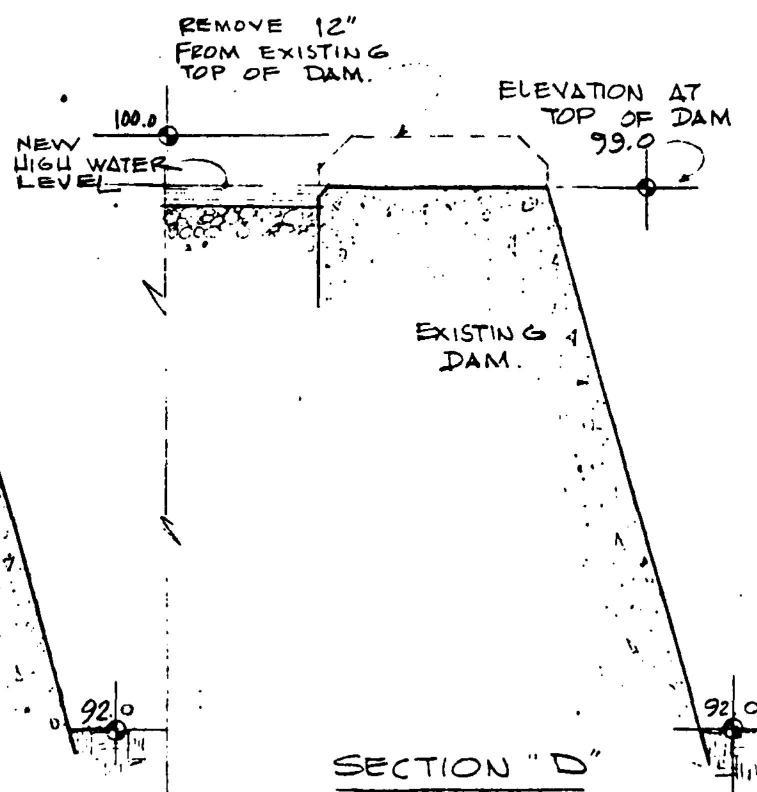
(FACING SOUTH) Scale 1/8"=1'0"



ELEVATION "B"
(FACING NORTH) Scale 1/8"=1'-0"



SECTION "C"
Scale 3/8"=1'-0"

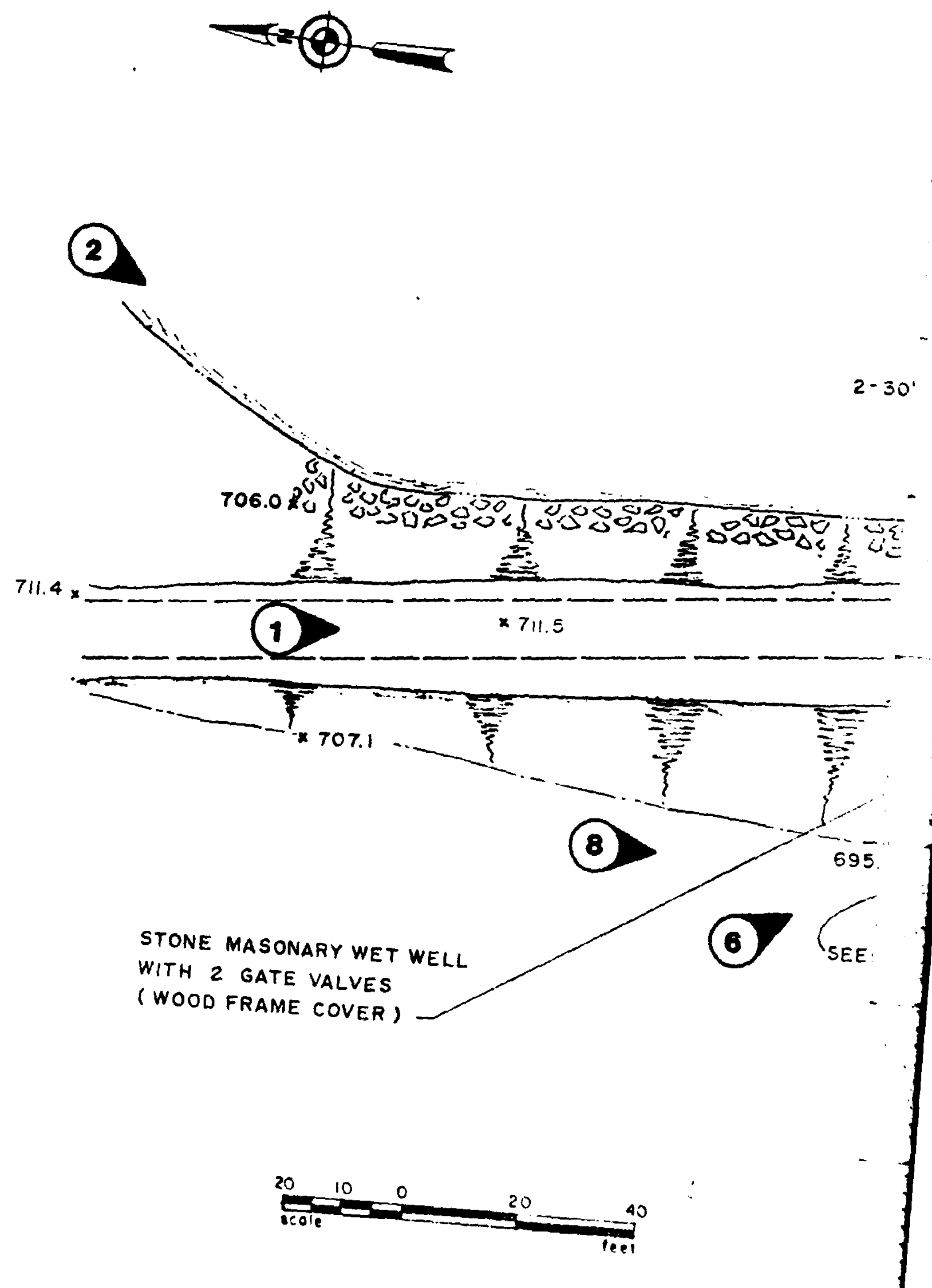


SECTION "D"
Scale 3/8"=1'-0"

ARCHITECTURAL & FACILITIES PLANNING	
MASHAPAUG POND - DAM REMOVAL OF SECTION TO LOWER HIGH WATER LEVEL BY 12"	American Optical
DR BY MARAM / DATE 10.1.79 / TUBE NO / CKD BY / APPROV BY / SCALE AS NOTED	PL-7667

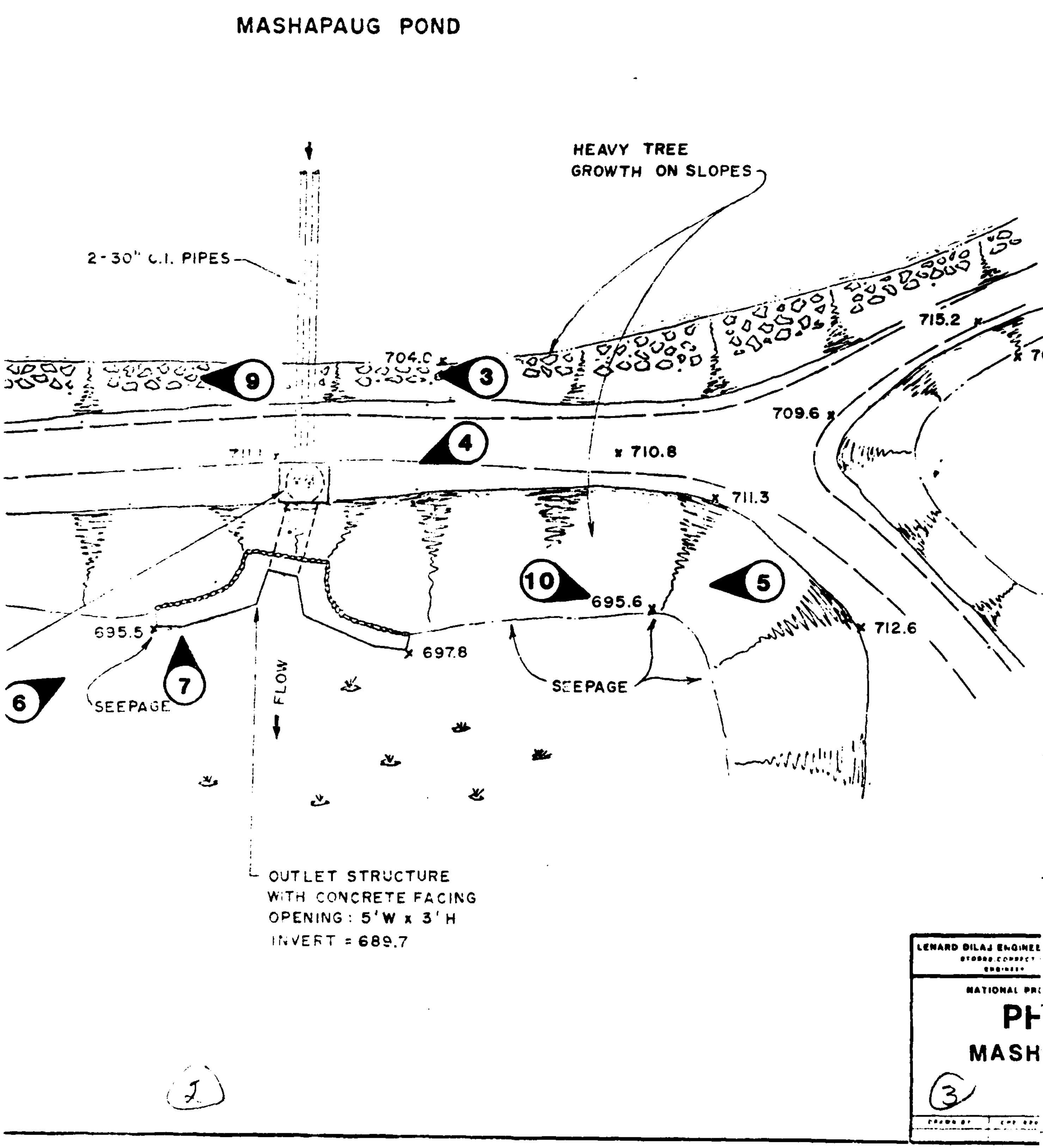
APPENDIX C

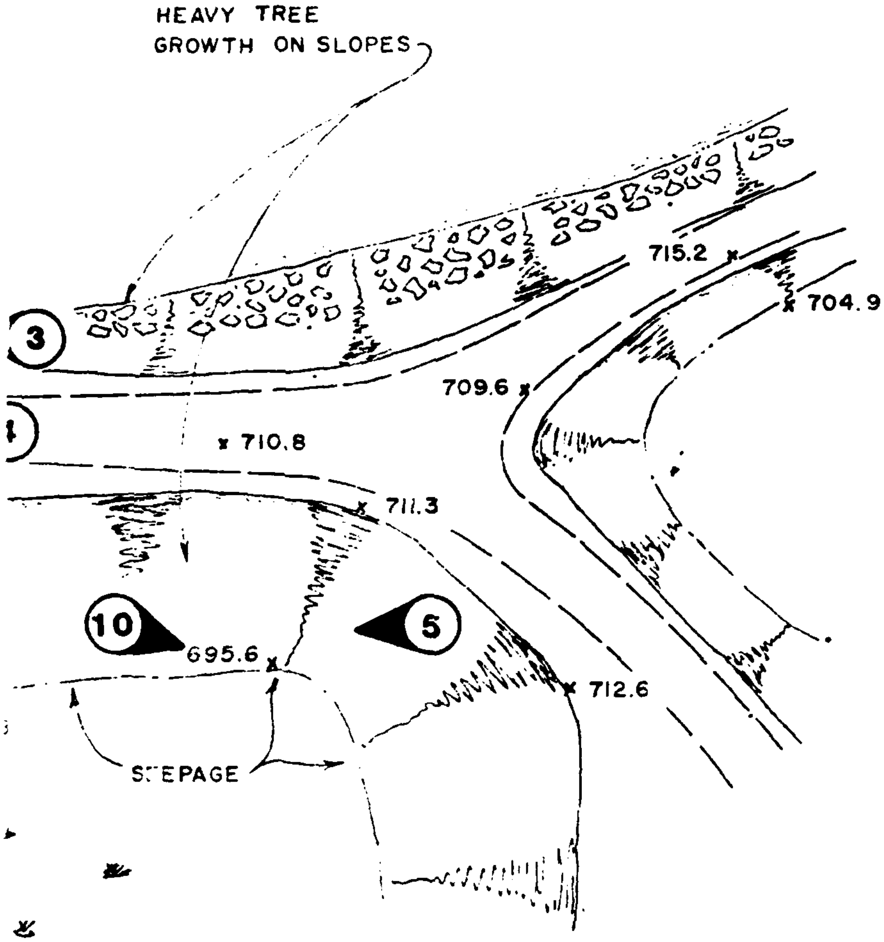
PHOTOGRAPHS



2-30'
706.0
711.4
711.5
707.1
695.
STONE MASONARY WET WELL
WITH 2 GATE VALVES
(WOOD FRAME COVER)
SEE
20 10 0 20 40
scale
feet

(1)


MASHAPAUG POND
HEAVY TREE GROWTH ON SLOPES
2-30" C.I. PIPES
704.0
715.2
709.6
710.8
711.3
695.6
712.6
695.5
697.8
SEEPAGE
SEEPAGE
FLOW
OUTLET STRUCTURE
WITH CONCRETE FACING
OPENING : 5'W x 3'H
INVERT = 689.7
9
3
4
10
5
7
6
2
3



LENARD DILAJ ENGINEERING, INC. | US ARMY ENGINEER DIV. NEW ENGLAND

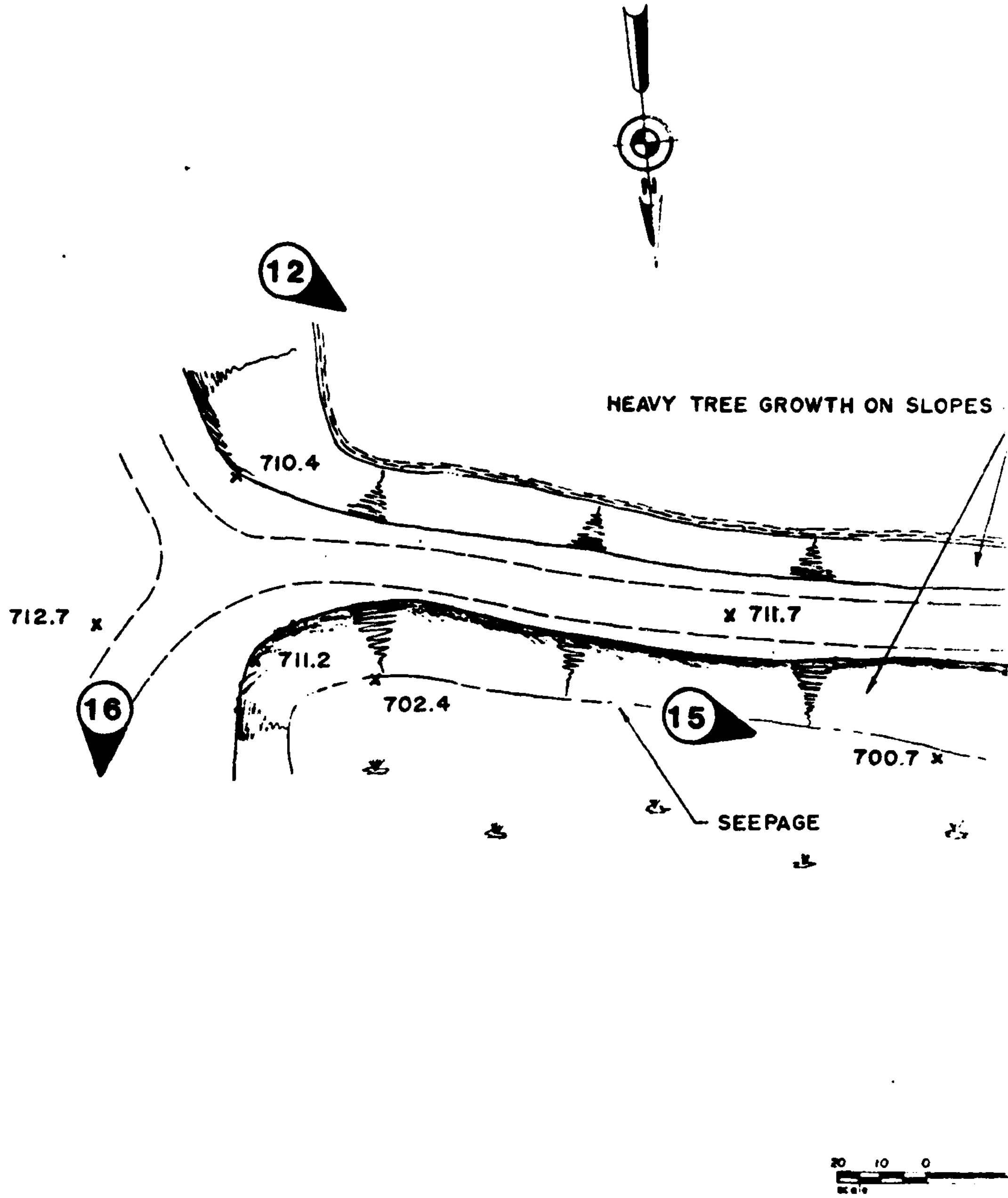
CORPS OF ENGINEERS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

PHOTO INDEX

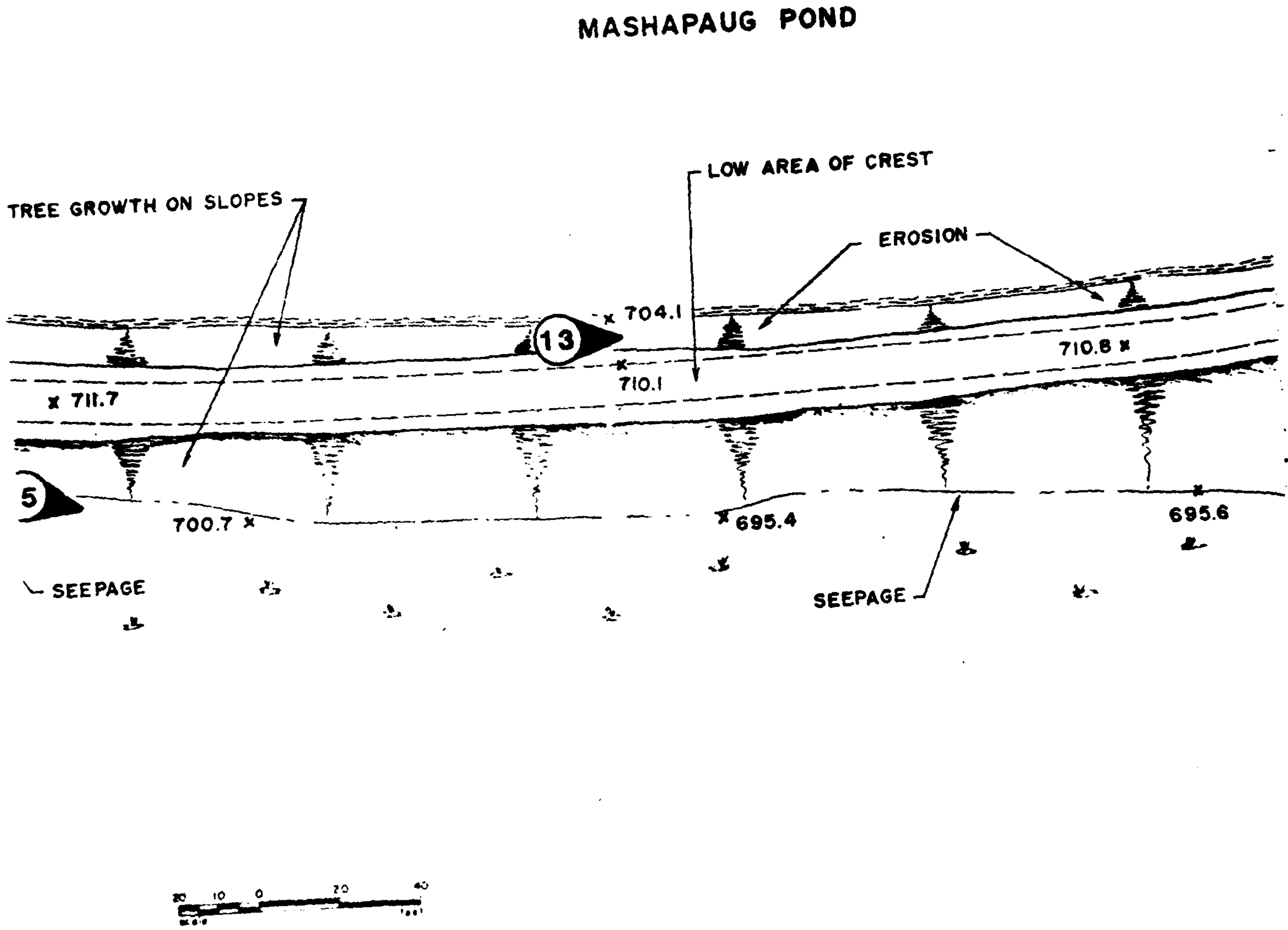
MASHAPAUG POND DAM

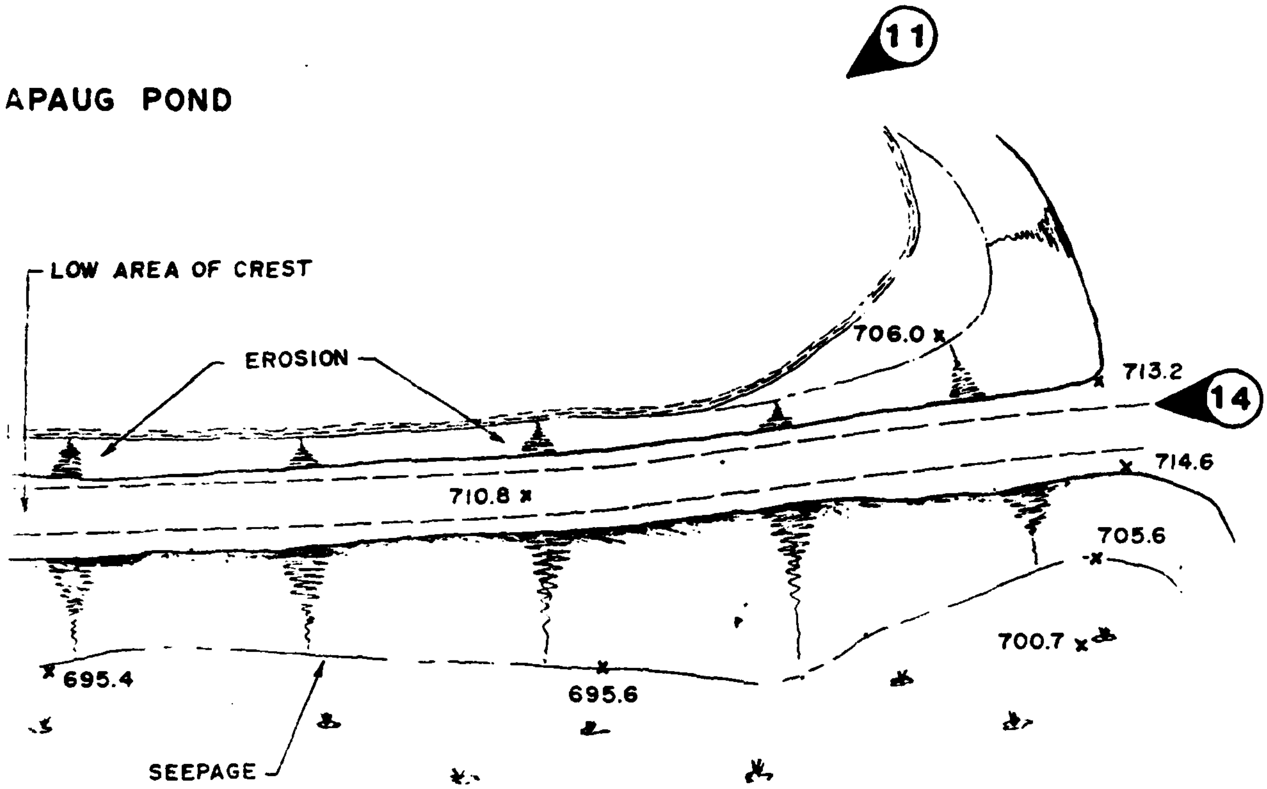
(3) UNION, CT.



12
HEAVY TREE GROWTH ON SLOPES
710.4
712.7 x
x 711.7
711.2
702.4
16
15
700.7 x
SEEPAGE
20 10 0

(1)


MASHAPAUG POND
LOW AREA OF CREST
TREE GROWTH ON SLOPES
EROSION
704.1
13
710.8
710.1
711.7
5
700.7
695.4
695.6
SEEPAGE
SEEPAGE



LENARD DILAJ ENGINEERING, INC.	US ARMY ENGINEER DIV. NEW ENGLAND

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

PHOTO INDEX
MASHAPAUG POND DIKE
UNION, CT.

3

DRAWN BY	CHECKED BY	APPROVED BY	SCALE
			DATE

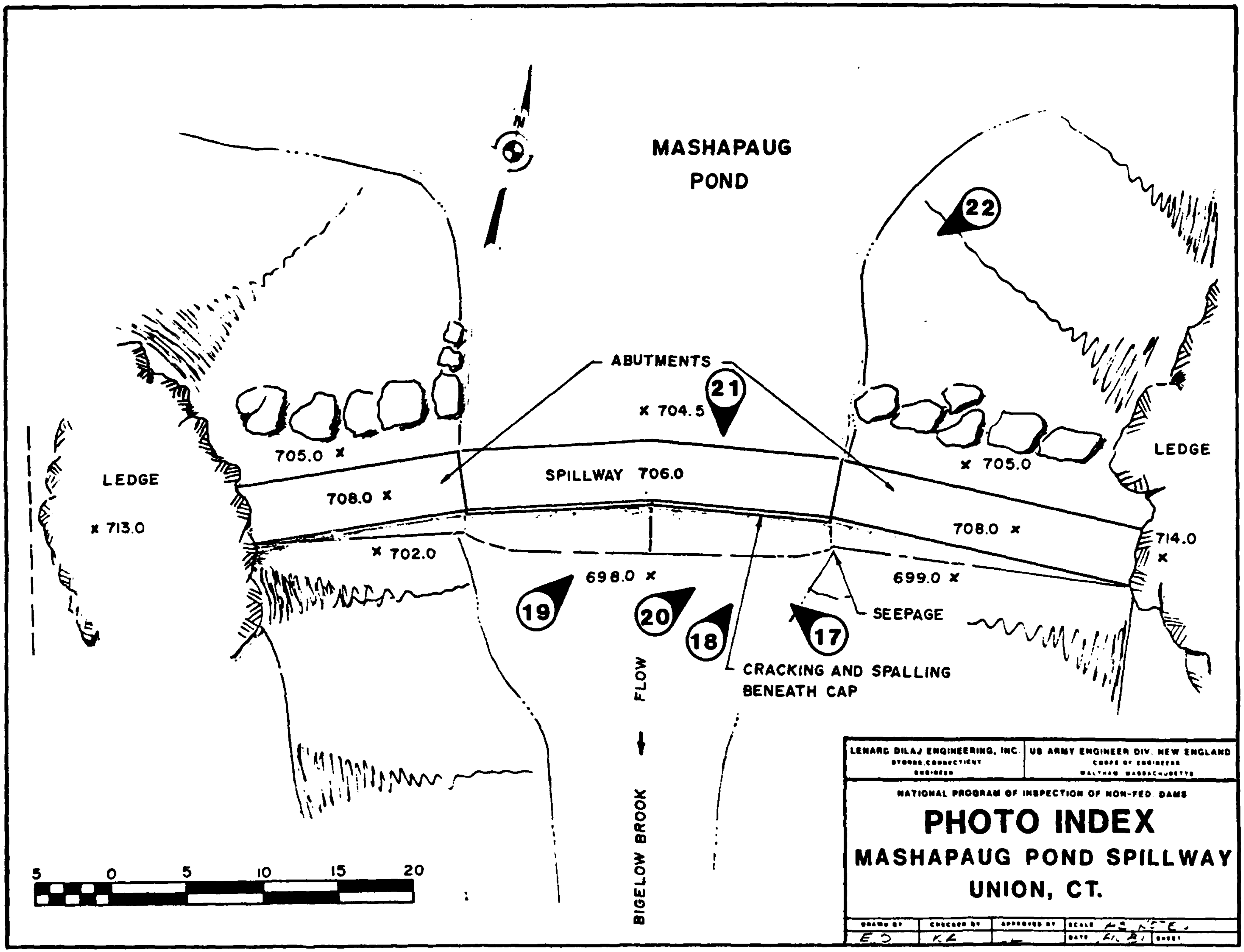

MASHAPAUG
POND
N
ABUTMENTS
21
x 704.5
SPILLWAY 706.0
705.0 x
708.0 x
x 702.0
LEDGE
x 713.0
x 705.0
708.0 x
LEDGE
714.0
x
698.0 x
699.0 x
19
20
18
17
22
SEEPAGE
CRACKING AND SPALLING
BENEATH CAP
FLOW
BIGELOW BROOK
5 0 5 10 15 20
LENARD DILAJ ENGINEERING, INC.
US ARMY ENGINEER DIV. NEW ENGLAND
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
PHOTO INDEX
MASHAPAUG POND SPILLWAY
UNION, CT.

Photo 1. Crest of dam looking from the right abutment towards the left abutment. Note the gate housing for the two 30-inch low level outlet pipes at the center of the picture.

Photo 2. Overall view of dam from right abutment. Note large trees growing over dam embankments and hand placed stone protection on upstream face. Approximate slope is 1.5H:1V.

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	**NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS**	MASHAPAUG POND DAM UNION, CONNECTICUT CT 01700
LENARD-DILAJ ENGINEERING, INC. STORRS, CONNECTICUT ENGINEER		JAN. 1981 C-2

Photo 3. Concrete blocks on upstream slope. Tree in background has a nail marker used to control water level in reservoir. When water is at that level, the gate is opened. Note riprap protection along water line.

Photo 4. Outlet control structure. Outlet works consists of two 30-inch pipes entering into a circular intake chamber with valves. Outlet from this chamber is a 3'x 5' conduit.

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	MASHAPAUG POND DAM UNION, CONNECTICUT CT 01700 JAN. 1981
LENARD-DILAJ ENGINEERING, INC. STORRS, CONNECTICUT ENGINEER		C-3

Photo 5. Downstream slope from left abutment. Approximately 1.3H:1V. Note extensive tree growth and tailwater at base of dam.

Photo 6. Downstream face of outlet structure. This structure is a concrete cap on an older masonry wall.

Photo 7. Closeup of downstream wall. Note seepage along end of wall.

Photo 8. Seepage area left of downstream outlet structure. Note rust colored water which appears to be rising up from the foundation soils.

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	MASHAPAUG POND DAM UNION, CONNECTICUT CT 01700 JAN. 1981 C-5
LENARD-DILAJ ENGINEERING, INC. STORRS, CONNECTICUT ENGINEER		

Photo 9

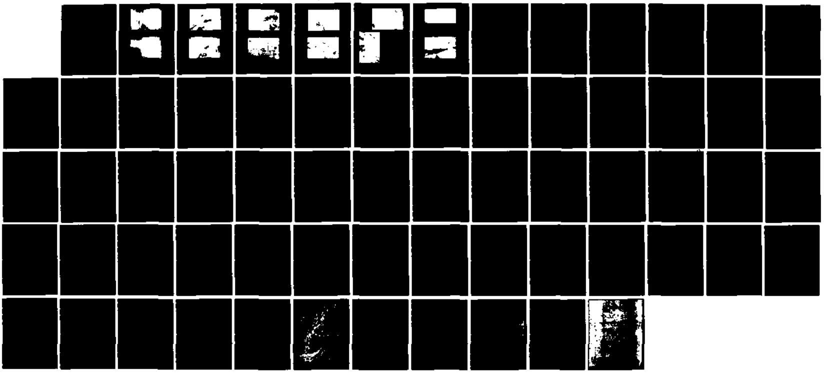
Closeup of hand placed stone protection on upstream face of dam. Note large tree and bulging as a consequence of this growth.

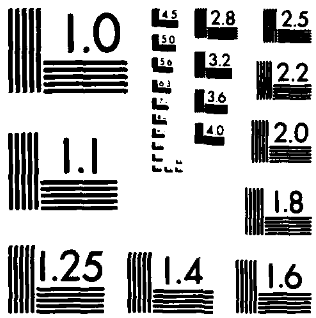
Photo 10

Seepage along toe of dam downstream slope. Mostly obscured by tailwater, except in locations of heavier flow, such as in photo, taken approximately 30 feet from left abutment.

AD-A144 580 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS MASHHPAUG POND SPILLW..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV MAR 81 2/2

UNCLASSIFIED F/G 13/13 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Photo 11. View of left side of dike on upstream slope. Note concrete block repairs, intermittent collapse of these repaired sections, and extensive tree growth on the upstream slope.

Photo 12. Overall view of dike from right abutment. Note heavy tree growth. Riprap protection is approximately 1.5H:1V.

Photo 13. Closeup of collapsed concrete block wall. Note the gravelly sand which comprises the embankment slope, and riprap areas with a 2:1 slope. Sloughing has probably caused steeper slopes in some of these areas.

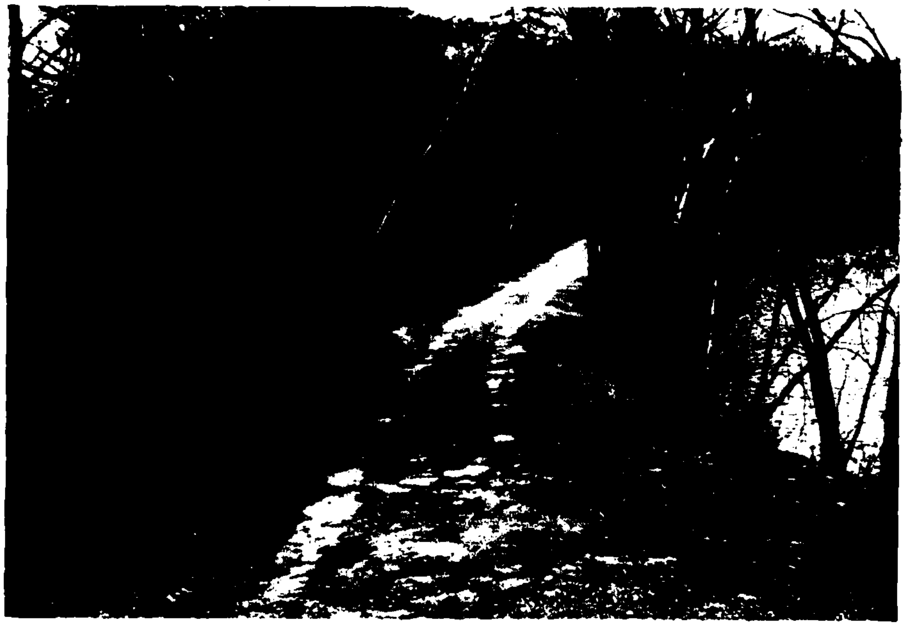


Photo 14. Overall view of dike from left abutment. Note extensive tree growth on both embankments.

Photo 15. Overall view of wet area downstream of dike.

Photo 16. Newly exposed face in borrow area.near right abutment of dike.

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS LENARD-DILAJ ENGINEERING, INC. STORRS,CONNECTICUT ENGINEER	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	MASHAPAUG POND DIKE UNION, CONNECTICUT CT 01699 JAN. 1981 C-9

Photo 17. Downstream face of spillway. Note construction joint below spillway crest and spalling on face of dam.

Photo 18. Closeup of spalling on left side of spillway weir.

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS LENARD-DILAJ ENGINEERING, INC. STORRS, CONNECTICUT ENGINEER	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	MASHAPAUG POND SPILLWAY UNION, CONNECTICUT CT 00640 JAN. 1981 C-10

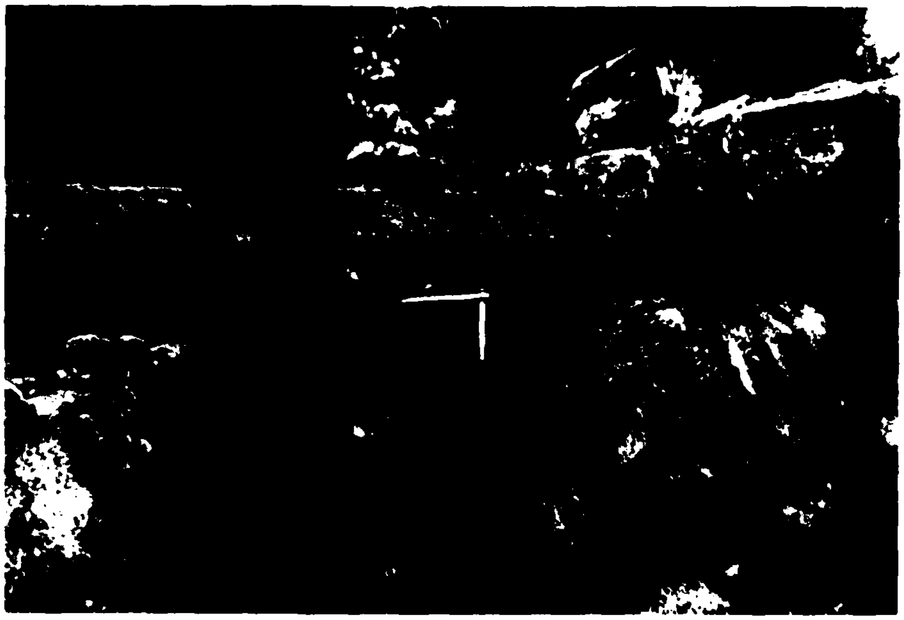


Photo 19

Closeup of construction joint below cap of spillway weir.

Photo 20

Closeup view of crack and seepage between low rock and concrete abutment at left side of dam. Seepage apparently emanates from the abutment.

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	**NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS**	MASHAPAUG POND SPILLWAY UNION, CONNECTICUT CT 00640 JAN. 1981
LENARD-DILAJ ENGINEERING, INC. STORRS, CONNECTICUT ENGINEER		C-11

Photo 21. Downstream channel viewed from spillway crest. Note rust stained water approximately 30 feet downstream of spillway.

Photo 22. Upstream of spillway. Note siltation at low water level. Water level is lower during winter months to protect lake front docking facilities.

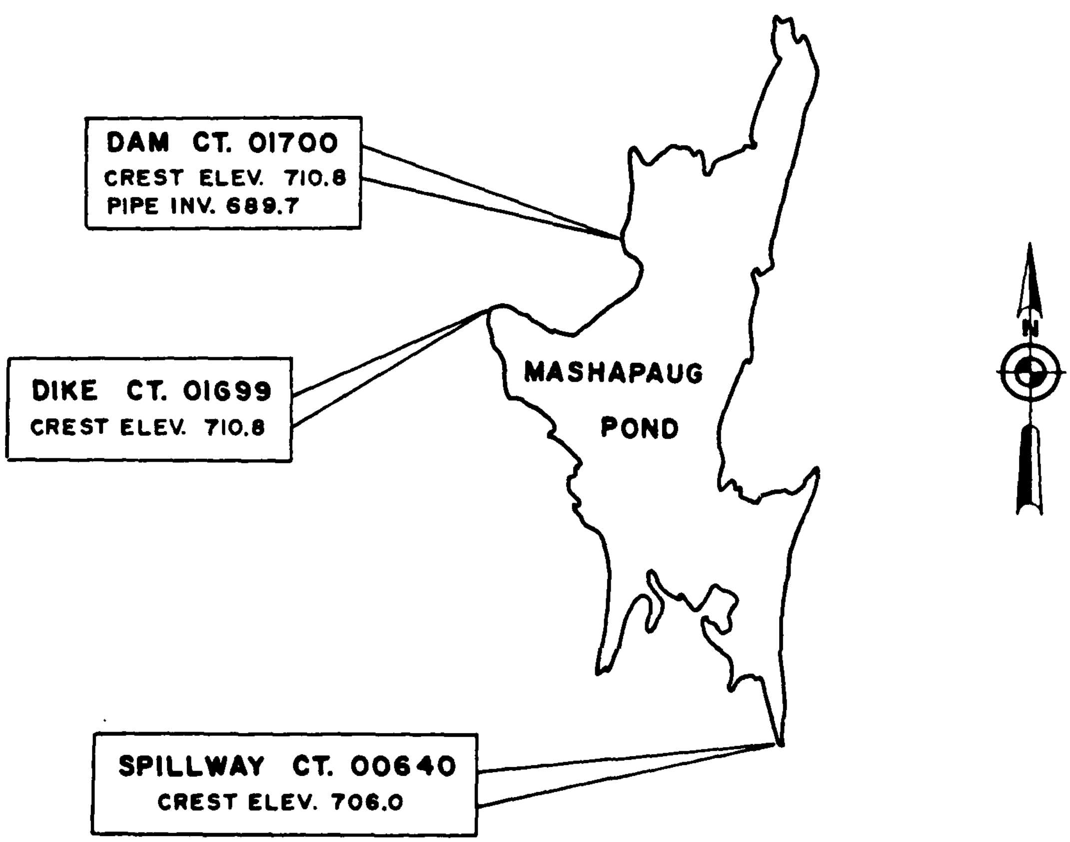
US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	MASHAPAUG POND SPILLWAY UNION, CONNECTICUT CT 00640 JAN. 1981
LENARD.DILAJ ENGINEERING, INC. STORRS,CONNECTICUT ENGINEER		C-12

APPENDIX D

HYDROLOGIC AND HYDRAULIC

COMPUTATIONS

THIS REPORT covers three facilities: the spillway structure, CT 00640, located at the southern end of the pond; the dike structure, CT 01699, located on the northwest side of the pond; and the dam structure, CT 01700, located at the northeast section of the pond. Jointly, these three facilities make possible the maintenance of the water level at Mashapaug Pond. Since all three structures are related to one pond, drawing on one watershed, and having identical hydrologic characteristics, the three structures were combined into one report. Throughout the report, however, each structure is discussed separately and on its own merit.



LENARD & DILAJ ENGINEERING, INC.
1066 Storrs Road
STORRS, CONNECTICUT 06268
(203) 429-7308

JOB MASHAPAUG POND DAM
SHEET NO. ______ OF ______
CALCULATED BY K. A. DATE 3/3/81
CHECKED BY ______ DATE ______
SCALE ______

DETERMINATION OF SPILLWAY TEST FLOOD*

A. SIZE CLASSIFICATION

Based on either storage or height

			THIS DAM:
Small	Storage	50-999 Ac.-Ft.	
	Height	25-39 Ft.	
Intermediate	Storage	1,000-50,000 Ac.Ft.	6725 Ac.Ft.
	Height	40-100 Ft.	15.3 FT.
Large	Storage	More than 50,000 Ac.-Ft.	
	Height	Greater than 100 Ft.	

B. HAZARD POTENTIAL CLASSIFICATION

Category	Loss of Life	Economic Loss
Low	None expected	Minimal
Significant	Few	Appreciable
High	More than few	Excessive

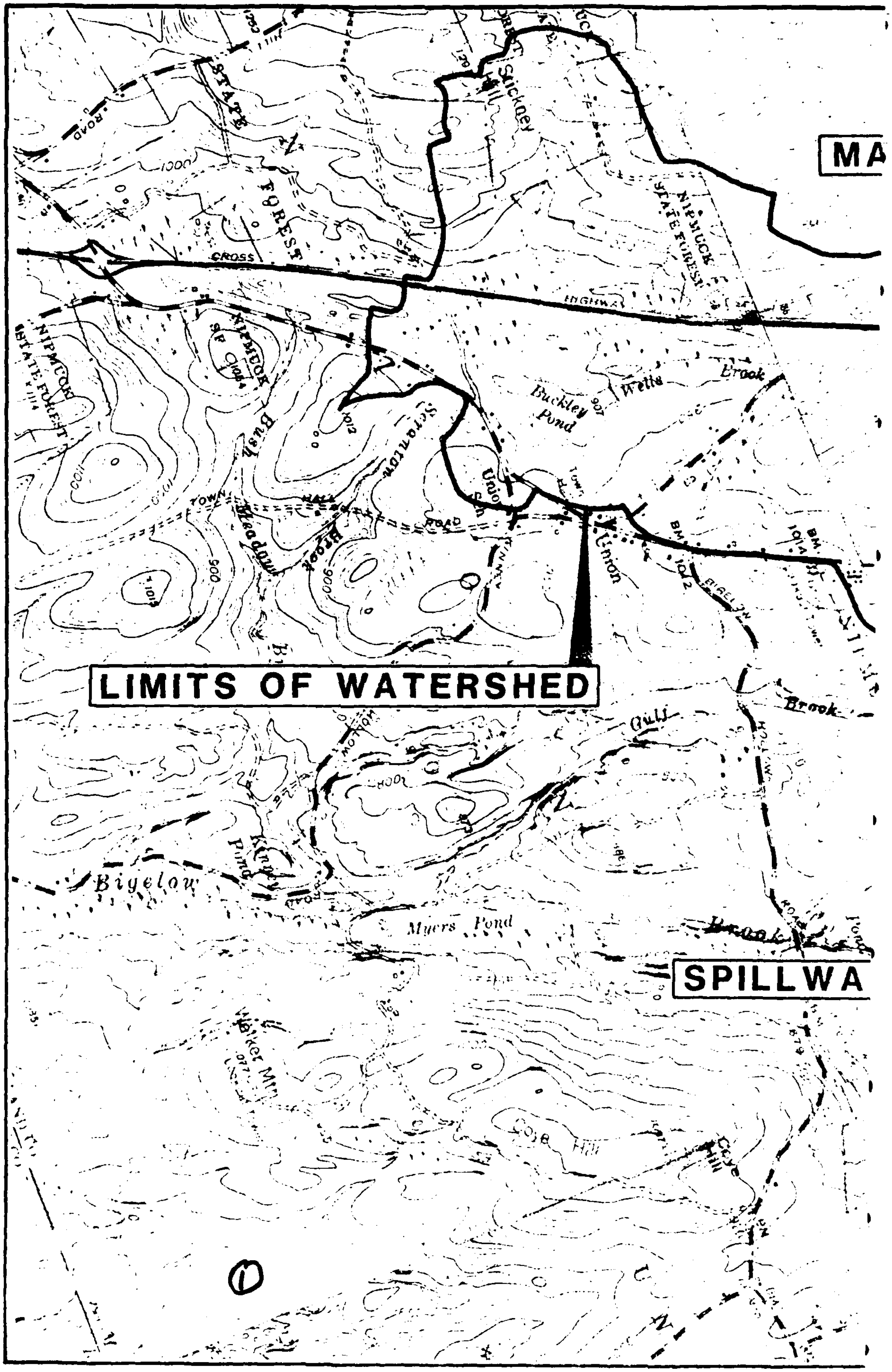
Hazard Classification HIGH

C. HYDROLOGIC EVALUATION GUIDELINES

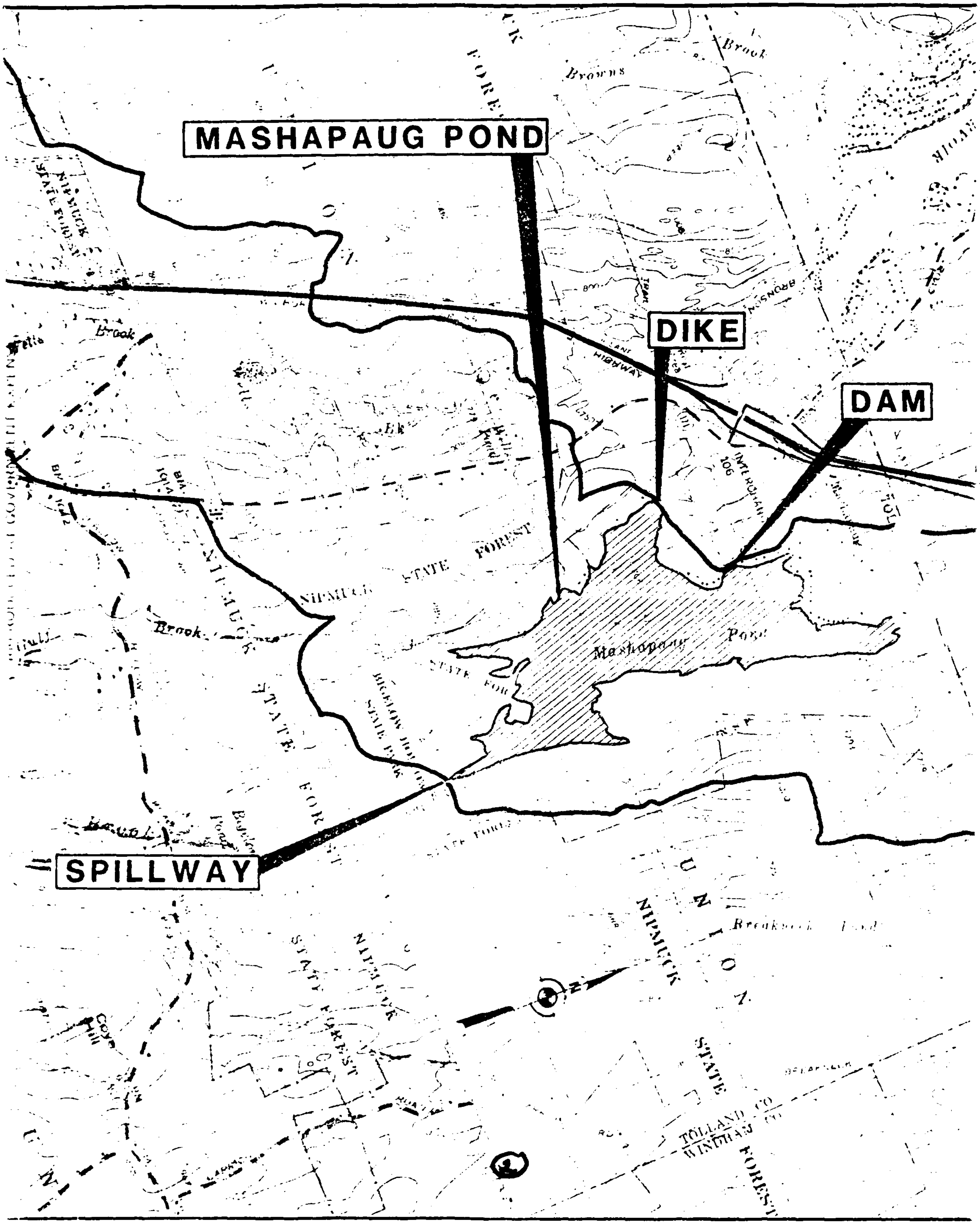
Hazard	Size	Spillway Test Flood
Low	Small	50 to 100-Year Frequency
	Intermediate	100-Year Frequency to ½ PMF
	Large	½ PMF to PMF
Significant	Small	100-Year Frequency to ½ PMF
	Intermediate	½ PMF to PMF
	Large	PMF
High	Small	½ PMF to PMF
	Intermediate	PMF
	Large	PMF

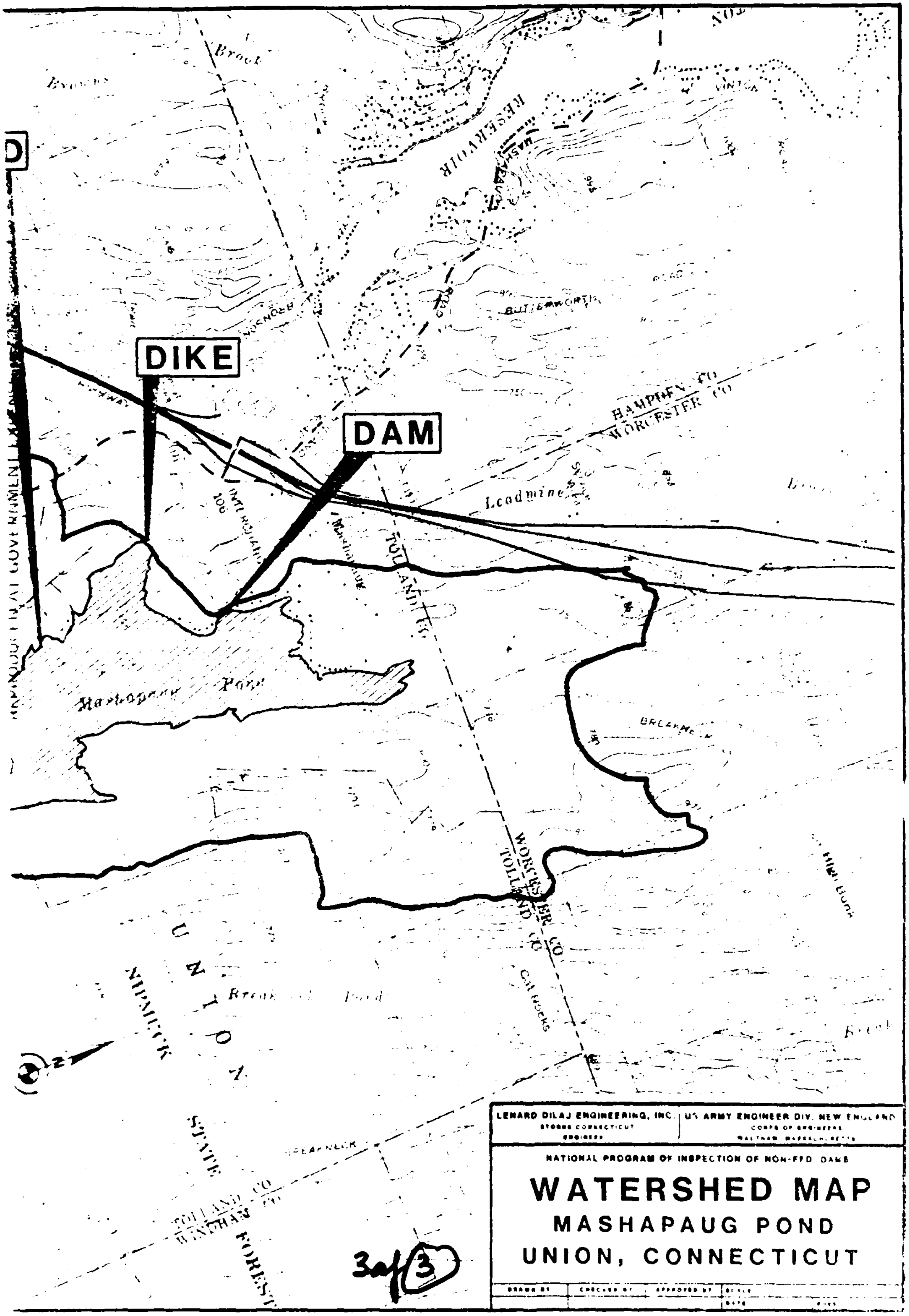
Spillway Test Flood PMF

* Based upon "Recommended Guidelines for Safety Inspection of Dams" Department of the Army, Office of the Chief of Engineers, November 1976.



MA
LIMITS OF WATERSHED
SPILLWA
NIPMUCK STATE FOREST
STATE FOREST
CROSS
HIGHWAY
Buckley Pond
Wells
Brook
Scranton
Bush
Meadow
Brook
TOWN
HALL
ROAD
Union
Bigelow
Myers Pond
Gulf
Brook
Cole Hill
1000
900


MASHAPAUG POND
DIKE
DAM
SPILLWAY
Mashapaug Pond
NIPMUCK STATE FOREST
BIGELOW HOLLOW STATE PARK
UNION
TOLLAND CO
WINDHAM CO
Browns
Brook
HIGHWAY



LENARD DILAJ ENGINEERING, INC.
US ARMY ENGINEER DIV. NEW ENGLAND

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

WATERSHED MAP
MASHAPAUG POND
UNION, CONNECTICUT

3 of 3

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
END OF NETWORK	

WATERSHED ANALYSIS

FOR

MASHAPAUG POND

(1)

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********************************

RUN  DATED 02/05/81.
      TIMED 13.39.29.


                    MASHAPAUG POND DAM    UNION  CONNECTICUT
                    80-27-4
                    JANUARY 1981    DESIGN STORM--- PMF

                                  JOB SPECIFICATION
              NQ     NHR    NMIN    IDAY     IHR    IMIN   METRC    IPLT    IPRT   NSTAN
             150       6      30       0       0       0       0       0       4       0
                                   JOPER     NWT   LROPT   TRACE
                                       5       0       0       0

                          MULTI-PLAN ANALYSES TO BE PERFORMED
                               NPLAN= 1 NRTIO= 6 LRTIO= 1
               RTIOS=    .10    .20    .30    .50    .80   1.00


        **********      **********      **********      **********      **********

                              SUB-AREA RUNOFF COMPUTATION

                  CALCULATION OF INFLOW HYDROGRAPH TO MASHAPAUG POND

                     ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                         1       0       0       0       1       0       1       0       0

                                    HYDROGRAPH DATA
             IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                 1       1    4.68    0.00    4.68    0.00   0.000       0       0       0

                                      PRECIP DATA
                      SPFE     PMS      R6     R12     R24     R48     R72     R96
                      0.00   24.00  100.00  111.00  120.00  127.00    0.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS  .800

                                       LOSS DATA
           LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
               0    0.00    0.80    1.00    0.00    0.00    1.00    1.00     .20    0.00    0.00

                                 UNIT HYDROGRAPH DATA
                            TP=  3.62     CP= .63     NTA=  0

                                     RECESSION DATA
                         STRTQ=   -1.80    QRCSN=    -.05    RTIOR= 1.00

             UNIT HYDROGRAPH 40 END-OF-PERIOD ORDINATES, LAG=   3.59 HOURS, CP=  .63  VOL= 1.00
            26.       95.      189.      295.      399.      480.      526.      533.      492.      425.
           365.      313.      269.      231.      198.      170.      146.      125.      108.       92.
            79.       68.       58.       50.       43.       37.       32.       27.       23.       20.
            17.       15.       13.       11.        9.        8.        7.        6.        5.        4.

      0                              END-OF-PERIOD FLOW
   MO DA   HR MN  PERIOD    RAIN    EXCS    LOSS    COMP Q    MO DA   HR MN  PERIOD    RAIN    EXCS    LOSS    COMP Q
```

(2)

SUM 24.38 18.91 5.47 128975.
(619.)(480.)(139.)(3652.17)

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTED FLOWS THROUGH MASHAPAUG POND DAM AND SPILLWAY

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	2	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-706.	-1

STAGE	706.00	707.00	708.00	709.00	710.00	711.00	712.00	714.00	716.00	718.00
FLOW	252.00	327.00	458.00	720.00	1108.00	1645.00	2291.00	3871.00	5542.00	7412.00

SURFACE AREA=	273.	295.	317.	337.	355.	370.	387.	401.
CAPACITY=	0.	568.	1180.	1834.	2526.	3250.	4007.	4795.
ELEVATION=	706.	708.	710.	712.	714.	716.	718.	720.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
706.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
710.8	2.6	1.5	783.

(8)

OVN

PEAK OUTFLOW IS 6129. AT TIME 45.00 HOURS

INFLOW/OUTFLOW HYDROGRAPH

MASHAPAUG POND

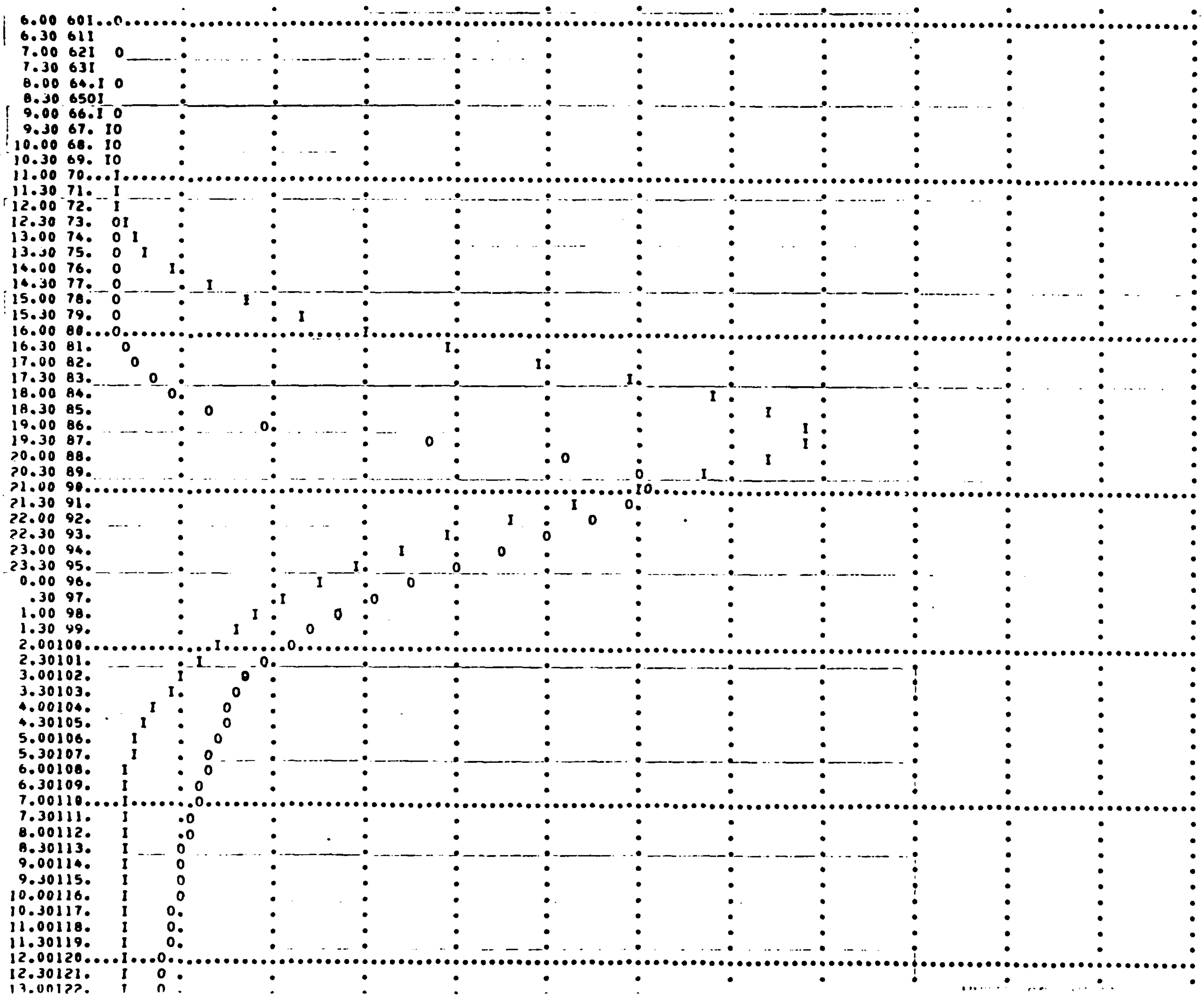
4

STATION 2

```
                    INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
         0.    1000.    2000.    3000.    4000.    5000.    6000.    7000.    8000.    0.    0.    0.    0.
  .30  1I
 1.00  2I  O
 1.30  3I
 2.00  4I  O
 2.30  5I
 3.00  6I  O
 3.30  7I
 4.00  8I  O
 4.30  9I
 5.00 10I..O.................................................................................
 5.30 11I
 6.00 12I  O
 6.30 13I
 7.00 14I  O
 7.30 15I
 8.00 16I  O
 8.30 17I
 9.00 18I  O
 9.30 19I
10.00 20I..O.................................................................................
10.30 21I
11.00 22I  O
11.30 23I
12.00 24I  O
12.30 25I
13.00 26I  O
13.30 27I
14.00 28I  O
14.30 29I
15.00 30I..O.................................................................................
15.30 31I
16.00 32I  O
16.30 33I
17.00 34I  O
17.30 35I
18.00 36I  O
18.30 37I
19.00 38I  O
19.30 39I
20.00 40I..O.................................................................................
20.30 41I
21.00 42I  O
21.30 43I
22.00 44I  O
22.30 45I
23.00 46I  O
23.30 47I
 0.00 48I  O
  .30 49I
 1.00 50I..O.................................................................................
 1.30 51I
 2.00 52I  O
 2.30 53I
 3.00 54I  O
 3.30 55I
 4.00 56I  O
 4.30 57I
 5.00 58I  O
 5.30 59I
 6.00 60I..O.................................................................................
 6.30 61I
```

(5)

6



```
14.30125.   I  O
15.00126.   I  O
15.30127.   I  O
16.00128.   I  O
16.30129.   I  O
17.00130....I..O
17.30131.   I  O
18.00132.   I  O
18.30133.   I O
19.00134.   I O
19.30135.   I O
20.00136.   I O
20.30137.   I O
21.00138.   I O
21.30139.   I O
22.00140....I.O
22.30141.   I O
23.00142.   I O
23.30143.   I O
 0.00144.   I O
  .30145.   I O
 1.00146.   I O
 1.30147.   IO
 2.00148.   IO
 2.30149.   IO
 3.00150....IO
```

7

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .10	RATIO 2 .20	RATIO 3 .30	RATIO 4 .50	RATIO 5 .80	RATIO 6 1.00
				RATIOS APPLIED TO FLOWS					
HYDROGRAPH AT	1	4.68	1	777.	1554.	2331.	3885.	6215.	7769.
	(	12.12)	(	22.00)(	44.00)(	66.00)(	110.00)(	176.00)(	220.00)(
ROUTED TO	2	4.68	1	300.	433.	678.	1400.	4195.	6129.
	(	12.12)	(	8.50)(	12.25)(	19.21)(	39.64)(	118.80)(	173.54)(

8

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	706.00	706.00	710.80
STORAGE	0.	0.	1436.
OUTFLOW	252.	252.	1538.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	706.64	0.00	177.	300.	0.00	47.50	0.00
.20	707.81	0.00	511.	433.	0.00	48.50	0.00
.30	708.84	0.00	820.	678.	0.00	48.50	0.00
.50	710.54	0.00	1354.	1400.	0.00	47.50	0.00
.80	711.80	1.00	1766.	4195.	7.50	45.50	0.00
1.00	712.27	1.47	1925.	6129.	9.00	45.00	0.00

9

LENARD & DILAJ ENGINEERING, INC.
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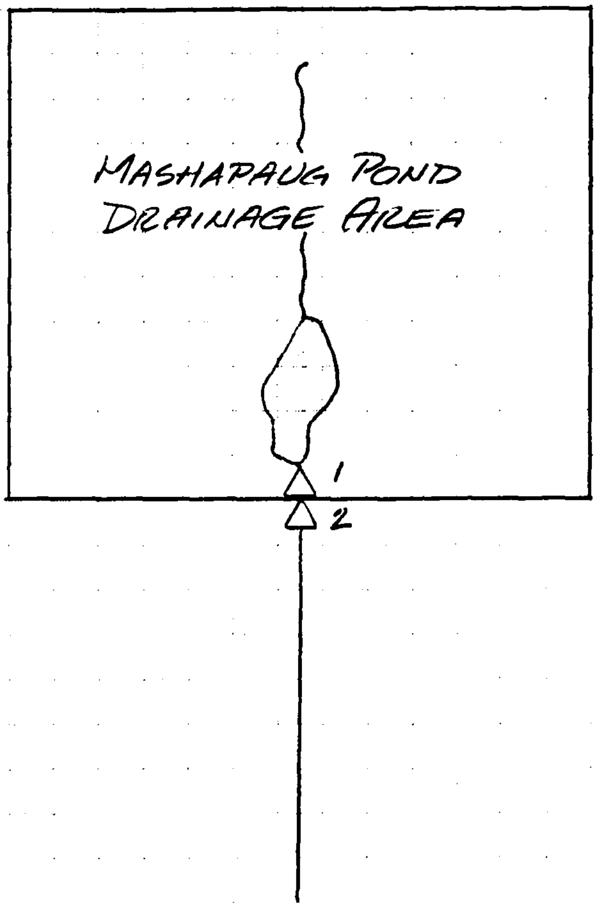
(203) 429-7308

80-27-4

JOB MASHAPAUG POND DAM
SHEET NO. 1 OF 9
CALCULATED BY K.A. DATE 12/8/80
CHECKED BY M.R. DATE 1/26/81
SCALE

SCHEMATIC - WATERSHED ANALYSIS



1 - INFLOW INTO MASHAPAUG POND
2 - INFLOW ROUTED THROUGH MASHAPAUG POND DAM, DIKE & SPILLWAY

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JOB MASHAPAUG POND DAM
SHEET NO. 2 OF 9
CALCULATED BY K.A. DATE 12/8/80
CHECKED BY M.R. DATE 1/26/81
SCALE

WATERSHED AREAS

WALES QUAD:

9020
7912
1108 grads ⇒ 2.75 S.M.

10134
9020
1114 grads ⇒ 2.76 S.M.

11243
10134
1109 grads ⇒ 2.75 S.M.   2.75 S.M.

SOUTHBRIDGE QUAD:

1868
1593
275 grads ⇒ 0.68 S.M.

1605
1327
278 grads ⇒ 0.68 S.M.

544
267
277 grads ⇒ 0.68 S.M.   0.68 S.M.

WESTFORD QUAD:

1868
1315
553 grads ⇒ 1.26 S.M.

3148
2600
548 grads ⇒ 1.25 S.M.

FORM 204-1 Available from NEBS Inc., Groton, Mass 01450

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JOB MASHAPAUG POND DAM
SHEET NO. 3 OF 9
CALCULATED BY K. A. DATE 12/8/80
CHECKED BY M.R. DATE 1/26/81
SCALE

3695
3148
547 grads ⇒ 1.25 S.M. — 1.25 S.M.

WATERSHED TOTAL — 4.68 S.M.

RESERVOIR SURFACE AREAS

ELEV. 706 (SPILLWAY):
170 grads
175 "
172 "
} 172 grads — 273 Ac.

ELEV. 710:
199 grads
200 "
201 "
} 200 grads — 317 Ac.

ELEV. 720:
250 grads
255 "
253 "
} 253 grads — 401 Ac.

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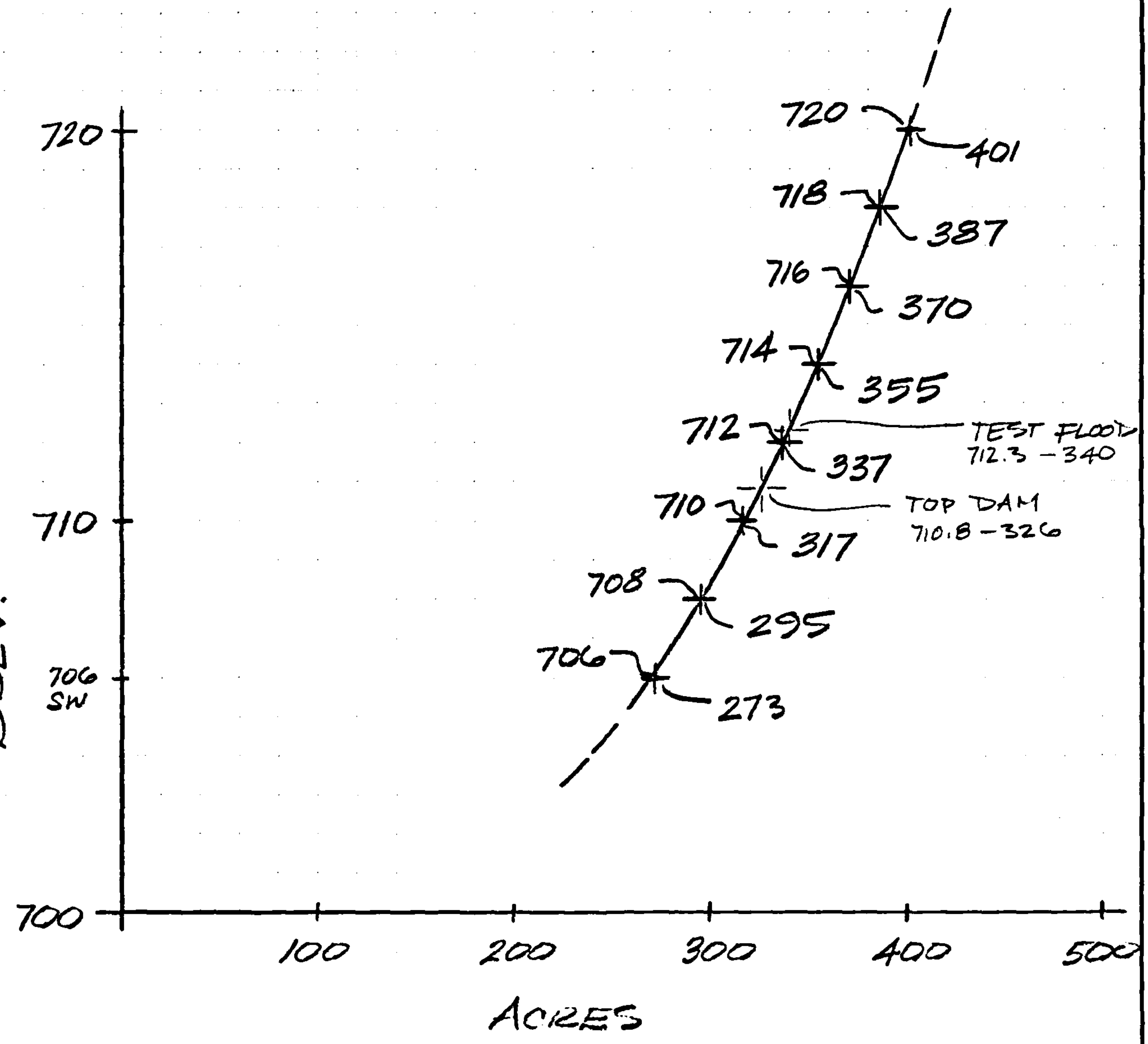
JOB MASHAPAUG POND DAM
SHEET NO 4 OF 9
CALCULATED BY K.A. DATE 12/8/80
CHECKED BY M.R. DATE 1/26/81
SCALE

SURFACE AREAS



NOTE: STORAGE AT SPILLWAY ELEV. = 5289 AC.-FT.
(BASED ON DEPTHS TAKEN FROM THE CONNECTICUT FISHERIES SURVEY.)
STORAGE AT TOP DAM ELEV. = 6725 AC.-FT.

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JOB MASHAPAUG POND DAM
SHEET NO. 5 OF 9
CALCULATED BY K.A. DATE 1-19-81
CHECKED BY MR DATE 1/20/81
SCALE

PRECIPITATION

U.S. WEATHER BUREAU
TECH. PAPER NO. 40

PMF – 6 HOUR
(10 S.M.) 24 INCHES

LAG TIME (SNYDER'S)

$$t_p = C_t (L L_{CA})^{0.3}$$

$C_t = 2.0$

$L = 26,415' = 5.00$ MI.

$L_{CA} = 10,998' = 2.08$ MI.

$$t_p = 2.0\left[(5.00)(2.08)\right]^{0.3}$$

$t_p = 4.04$ HRS.

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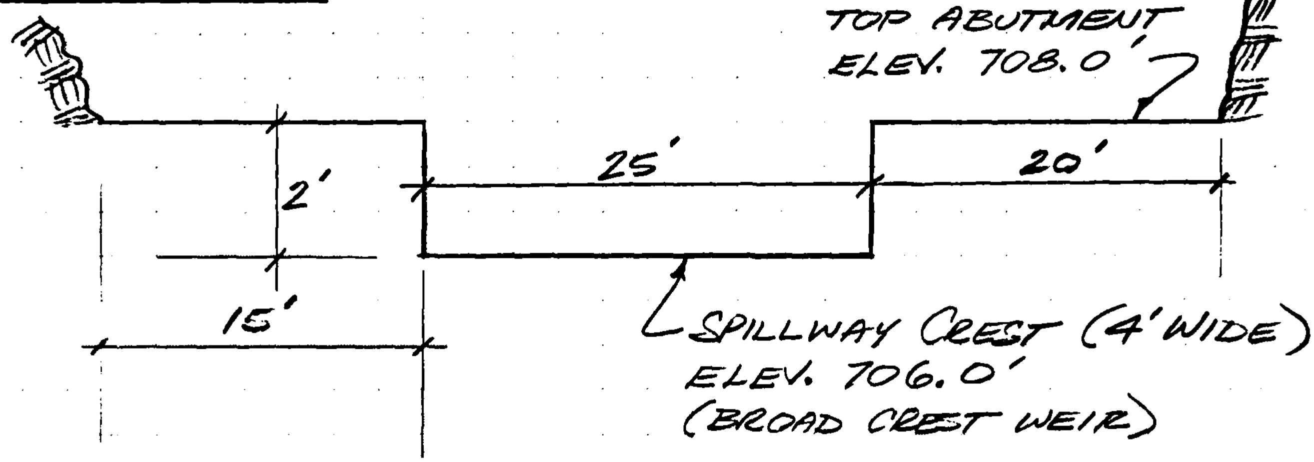
SPILLWAY



DISCHARGE: $Q = CLH^{1.5}$

SPILLWAY

Elev.	C	L	H	Q (CFS)
706.0	2.4	25'	0	0
707.0	2.7		1	68
708.0	2.7		2	191
709.0	2.7		3	351
710.0 (710.8)	2.8 (3.1)		4 (4.8)	560 (815)
711.0	3.1		5	866
712.0	3.3		6	1213
714.0	3.3		8	1867
716.0	3.3	25'	10	2609
718.0	3.3	25'	12	3429

ABUTMENT

Elev.	C	L	H	Q (CFS)
708.0	2.4	35'	0	0
709.0	2.7		1	95
710.0 (710.8)	2.7 (2.7)		2 (2.8)	267 (443)
711.0	2.7		3	491
712.0	2.8		4	784
714.0	3.3		6	1697
716.0	3.3	35'	8	2613
718.0	3.3	35'	10	3652

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JOB MASHAPAUG POND DAM
SHEET NO. 7 OF 9
CALCULATED BY K. A. DATE 1-19-81
CHECKED BY M.R DATE 1/26/81
SCALE

LOW LEVEL OUTLETS

CONTROL: 2 – 30" DIA. PIPE OPENINGS

$$Q = A\sqrt{\frac{2gH}{K}}$$

$A = 2(\pi r^2) = 9.82$ S.F.
$g = 32.2$ FT/S^2
$K = 1.6$

DISCHARGE

Elev.	A	g	K	H*	Q (CFS)
706.0	9.82	32.2	1.6	10.5	202
707.0				11.5	211
708.0				12.5	220
709.0				13.5	229
710.0 (710.8)				14.5 (15.3)	237 (244)
711.0				15.5	245
712.0				16.5	253
714.0				18.5	268
716.0	9.82	32.2	1.6	20.5	282
718.0	9.82	32.2	1.6	22.5	296

* NOTE: TAILWATER ELEV. = 695.5'

FORM 204-1 Available from NEBS Inc. Groton, Mass. 01450

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JOB MASHAPAUG POND DAM
SHEET NO. 8 OF 9
CALCULATED BY K. A. DATE 1/19/81
CHECKED BY M.R. DATE 1/26/81
SCALE

DISCHARGE SUMMARY

ELEV.	$Q_{SPILLWAY}$	$Q_{ABUTMENT}$	Q_{PIPES}	Q_{TOTAL}
706.0	0	0	202	202
707.0	68	0	211	279
708.0	191	0	220	411
709.0	351	95	229	675
710.0 (710.8)	560 (815)	267 (443)	237 (244)	1064 (1502)
711.0	866	491	245	1602
712.0	1213	784	253	2250
714.0	1867	1697	268	3832
716.0	2609	2613	282	5504
718.0	3429	3652	296	7377

TEST FLOOD LEVEL – PMF

712.3	1304	873	255	2432

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JOB MASHAPAUG POND DAM
SHEET NO. 9 OF 9
CALCULATED BY K.A. DATE 1/19/81
CHECKED BY M.R. DATE 1/26/81
SCALE

DAM LENGTH

MASHAPAUG SECTIONS:
DAM – 286'
DIKE – 497'
SPILLWAY (NO EMBANKMENTS)

TOTAL DAM LENGTH = 286' + 497'

(SPILLWAY NOT INCLUDED) L = 783'

DISCHARGE COEFFICIENT OVER DAM

C = 2.6

ELEVATIONS

TOP DAM: 710.8'

TOP DIKE: 710.8'

SPILLWAY CREST: 706.0'

SPILLWAY ABUTMENT: 708.0'

PIPE INVERTS (APPROX.): 689.7'

HEIGHTS – DAM: 15.3'
DIKE: 15.3'
SPILLWAY ABUTMENT: 10.0'

LENARD & DILAJ ENGINEERING, INC.
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DAM FAILURE ANALYSIS

LONGEST SECTION: DIKE – LENGTH = 497'

LENGTH AT MID-HEIGTH = 457'

PEAK FAILURE OUTFLOW:

$$Q_{P1} = 8/27\, W_b \sqrt{g}\, Y_0^{3/2}$$

WHERE, $W_b = 0.4 \times 457 = 183'$

$g = 32.2$ FT/S^2

$Y_0 = 15.3$ FT.

$$Q_{P1} = 8/27\,(183)\sqrt{32.2}\,(15.3)^{3/2}$$

$$\underline{Q_{P1} = 18{,}414 \text{ CFS}}$$

STORAGE: $\underline{S = 4105 \text{ AC.-FT.}}$ (See Sheet #2)

<u>NOTE:</u> ① AT SPILLWAY: $Q_p = 8/27\,(0.4 \times 43)\sqrt{32.2}\,(10)^{3/2} = \underline{915 \text{ CFS}}$
NO RESIDENCE WITHIN 100' OF BROOK FOR 4.5 MILES DOWNSTREAM. THUS, NO DANGER FROM SPILLWAY FAILURE.

② AT DAM: $Q_p = 8/27\,(0.4 \times 177)\sqrt{32.2}\,(15.3)^{3/2} = \underline{7124 \text{ CFS}}$
THIS REPRESENTS ONLY 40% OF THE OUTFLOW FROM THE DIKE FAILURE. THUS, THE DIKE REPRESENTS THE GREATER DANGER.

LENARD & DILAJ ENGINEERING, INC.
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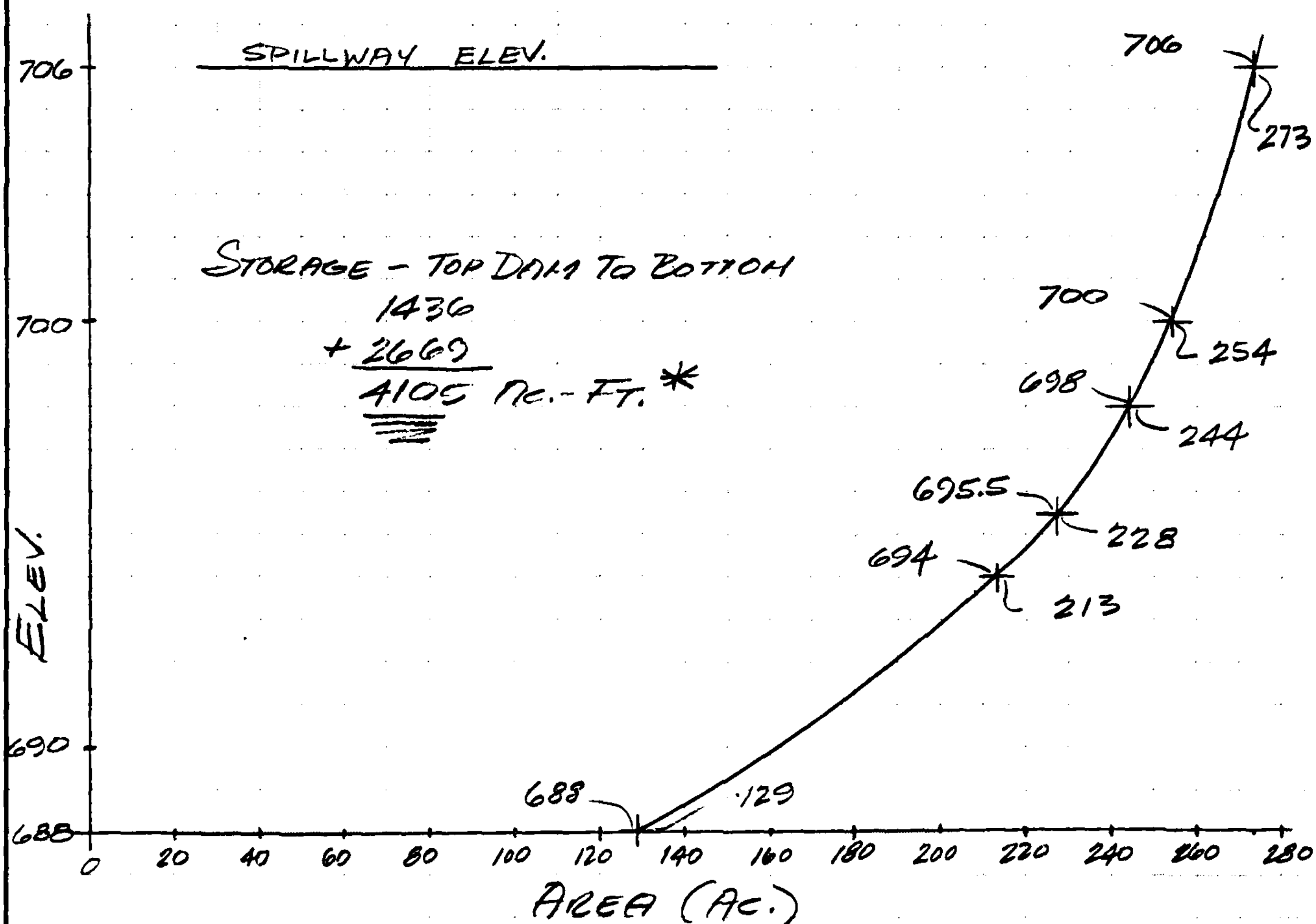
JOB MASHAPAUG POND DAM
SHEET NO. 2 OF 29
CALCULATED BY K. A. DATE 2/26/81
CHECKED BY M.R. DATE 3/5/81
SCALE

STORAGE - MASHAPAUG POND



From prior calculations:
Storage between 706.0 & 710.8 = 1436 Ac.-Ft.

Elev.	(H)	Surface Area	Ave. Area	Storage (Ac.-Ft.)
706		273		
	(6)		263.5	1581
700		254		
	(2)		249	498
698		244		
	(2.5)		236	590
695.5		228		
				2669 Ac.-Ft.

*Storage below Elev. 695.5 not significant for dam failure (2620 Ac.-Ft.)

LENARD & DILAJ ENGINEERING, INC.
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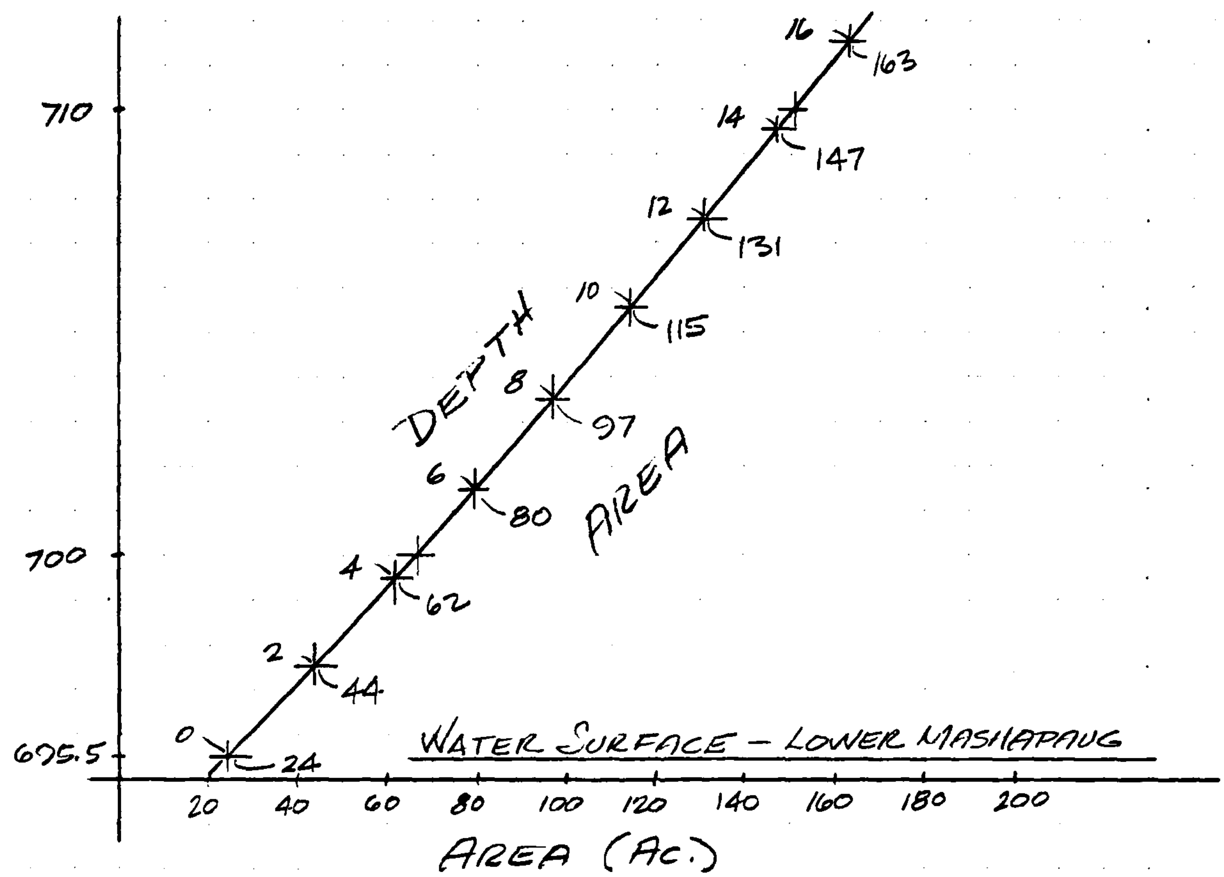
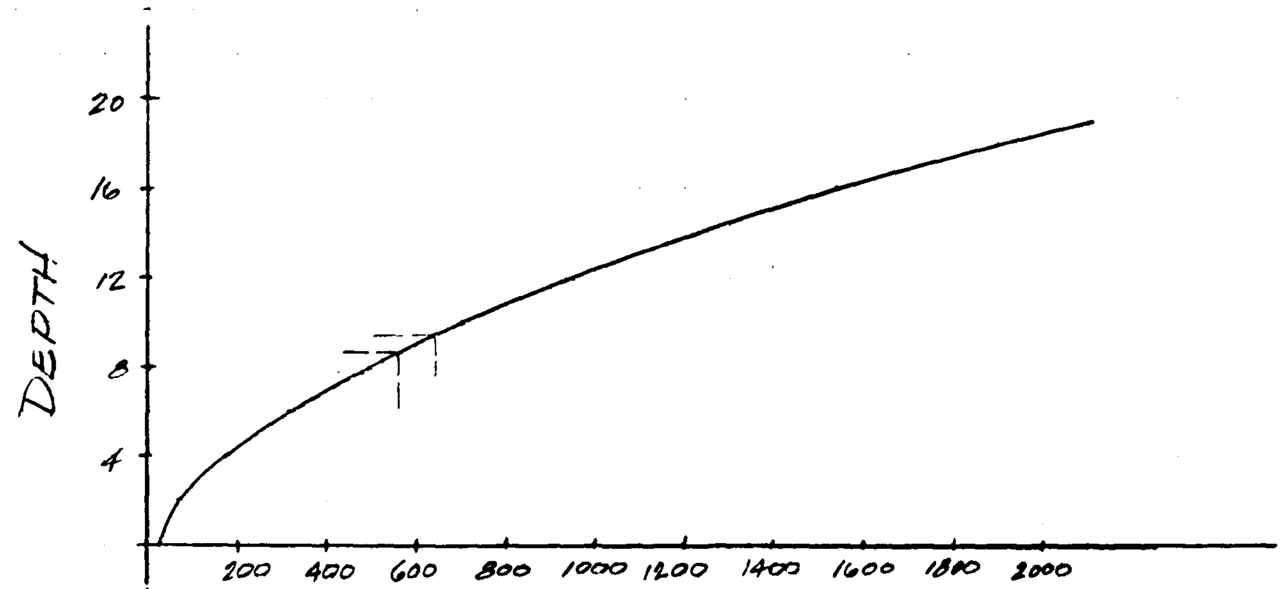
JOB MASHAPAUG POND DAM
SHEET NO. 3 OF 29
CALCULATED BY K. A. DATE 2/26/81
CHECKED BY MR DATE 3/5/81
SCALE

STORAGE – BETWEEN DAM & SECTION 1





– See Page 4

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STORRS, CONNECTICUT 06268
(203) 429-7308

JOB MASHAPAUG POND DAM

SHEET NO. 4 OF 29

CALCULATED BY K.A. DATE 2/26/81

CHECKED BY M.R. DATE 3/5/81

SCALE

STORAGE – BETWEEN DAM & SECTION 1 (CONT.)

DEPTH (FT.)		SURFACE AREA (AC.)	AVE. AREA (AC.)	STORAGE (AC.FT.) S	STORAGE (AC.FT.) ΣS
0		24			
	2		34	68	68
2		44			
	2		53	106	174
4		62			
	2		71	142	316
6		80			
	2		88.5	177	493
8		97			
	2		106	212	705
10		115			
	2		123	246	951
12		131			
	2		139	278	1229
14		147			
	2		155	310	1539
16		163			

FORM 204-1 Available from VEBS Inc., Groton, Mass 01450

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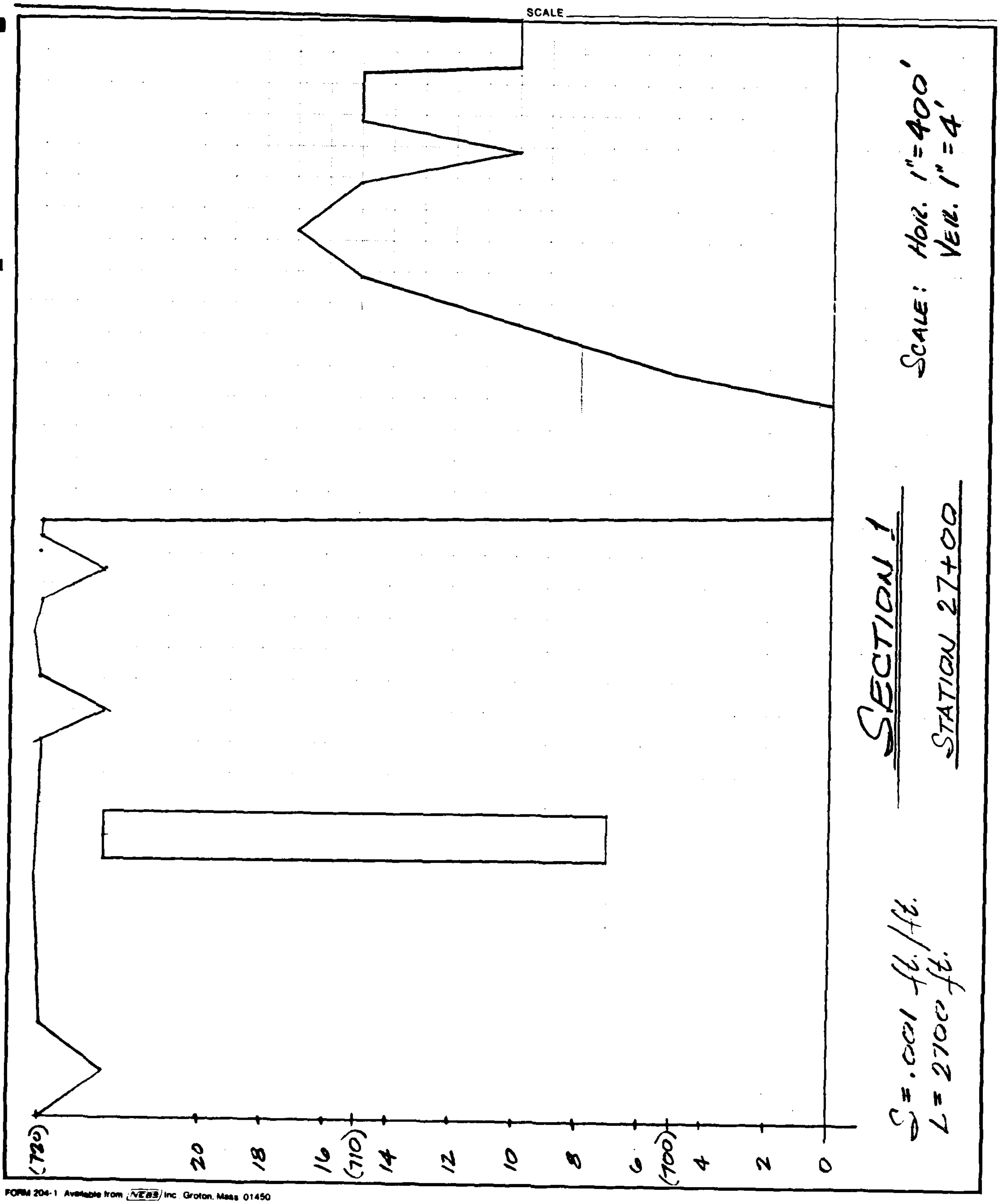
STORRS, CONNECTICUT 06268
(203) 429-7308

JOB: MASHAPAUG POND DAM
SHEET NO. 5 OF 29
CALCULATED BY: K. A. DATE: 2/26/81
CHECKED BY: MR DATE: 3/5/81
SCALE:



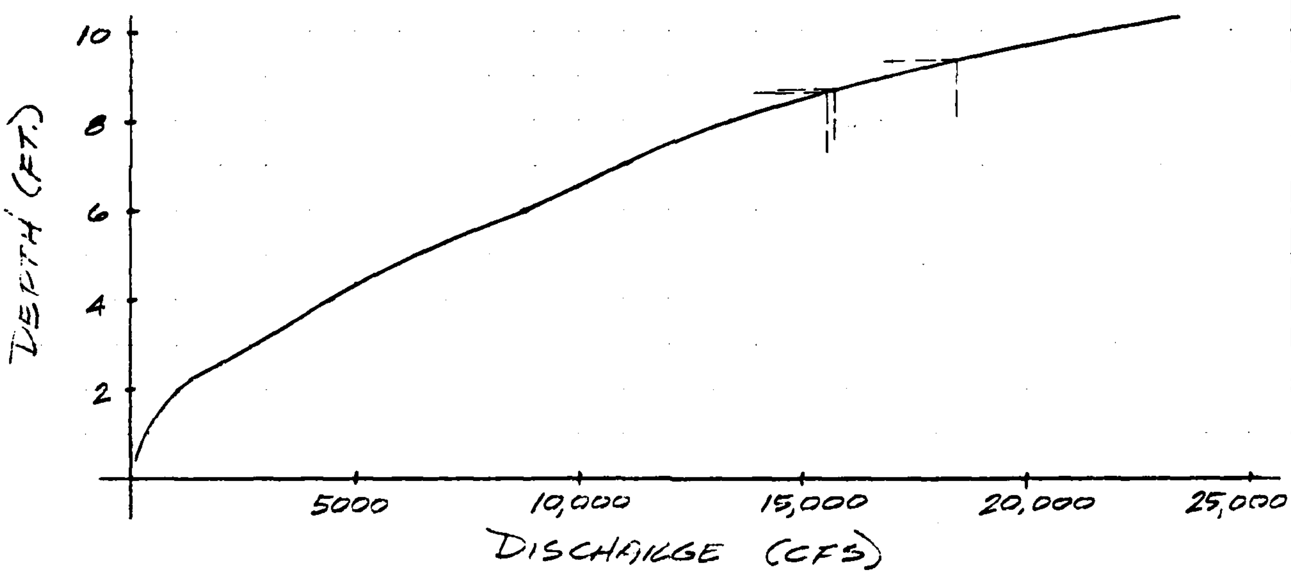
FORM 204-1 Available from NEBS Inc. Groton, Mass. 01450

LENARD & DILAJ ENGINEERING, INC.
1066 Storrs Road
STORRS, CONNECTICUT 06268
(203) 429-7308

JOB MASHAPAUG POND DAM
SHEET NO. 6 OF 29
CALCULATED BY K.A. DATE 2/26/81
CHECKED BY M.R. DATE 3/6/81
SCALE

SECTION 1 (CONT)

H	A	WP	R	n	V	Q(cfs)
2	750	400	1.9	.05	1.4	1050
4	1590	440	3.6	.04	2.8	4452
6	2520	490	5.1	.04	3.5	8820
8	3710	700	5.3	.04	3.6	13356
10	5180	770	6.7	.04	4.2	21,756
12	7170	1070	6.7	.04	4.2	30,114



Q_{P_1} = 18,414 cfs

H = 9.4 ft.

V_1 = 645 ac. ft. *

Q_{P_2} (TRIAL) = 15,520 cfs

H = 8.6 ft.

V_2 = 560 ac. ft. *

Q_{P_2} = 15,711 cfs

H = 8.7 ft.

* See Sheet No. 3

LENARD & DILAJ ENGINEERING, INC.
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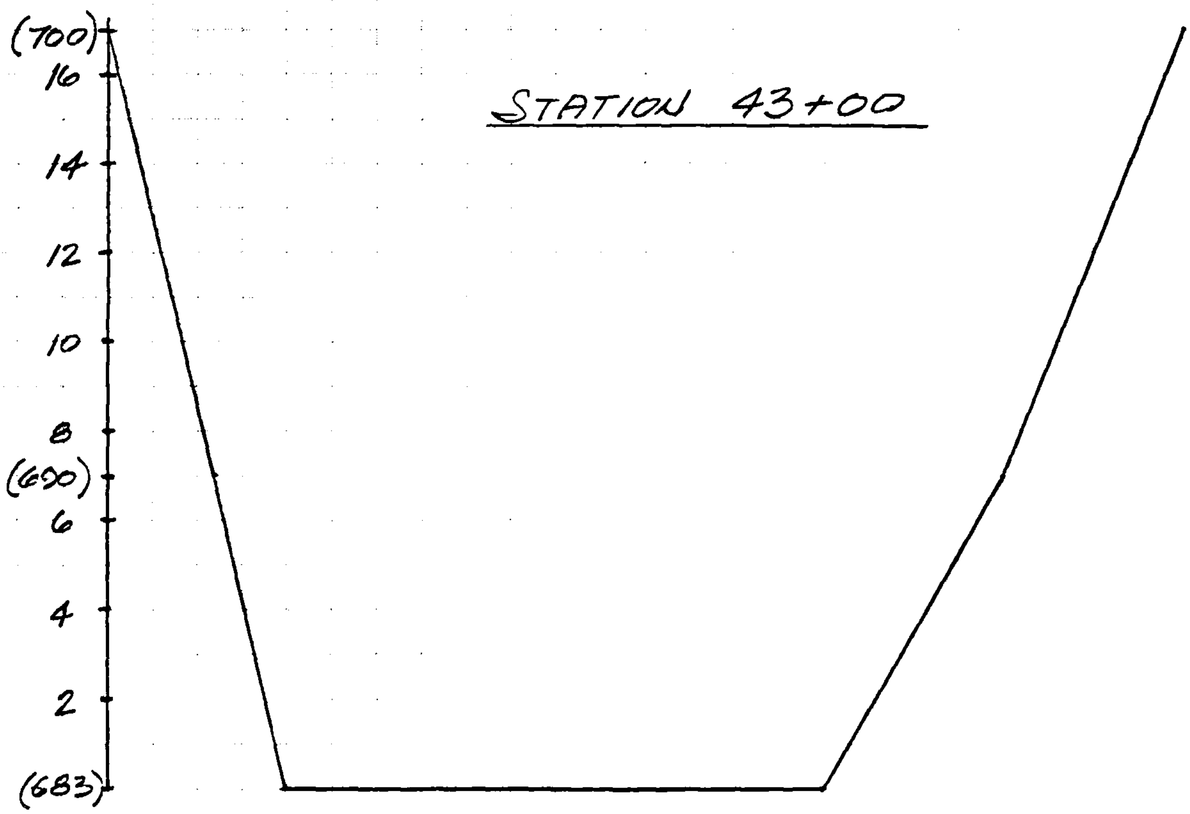
JOB MASHAPAUG POND DAM
SHEET NO 7 OF 29
CALCULATED BY K. A. DATE 2/26/81
CHECKED BY M. R DATE 3/6/81
SCALE

SECTION 2

SCALE: HOR. 1" = 50'
VER. 1" = 4'

STATION 43+00



H	A	WP	R	n	V	Q (cfs)
2	320	170	1.9	.04	1.8	576
4	680	190	3.6	.04	2.8	1904
6	1080	210	5.1	.04	3.5	3780
8	1520	230	6.6	.04	4.1	6232
10	1994	244	8.2	.04	4.8	9571
12	2498	260	9.6	.04	5.3	13,240
14	3034	276	11.0	.04	5.8	17,597

L = 1600 ft. ✓
S = .001 ft./ft.

LENARD & DILAJ ENGINEERING, INC.
1066 Storrs Road
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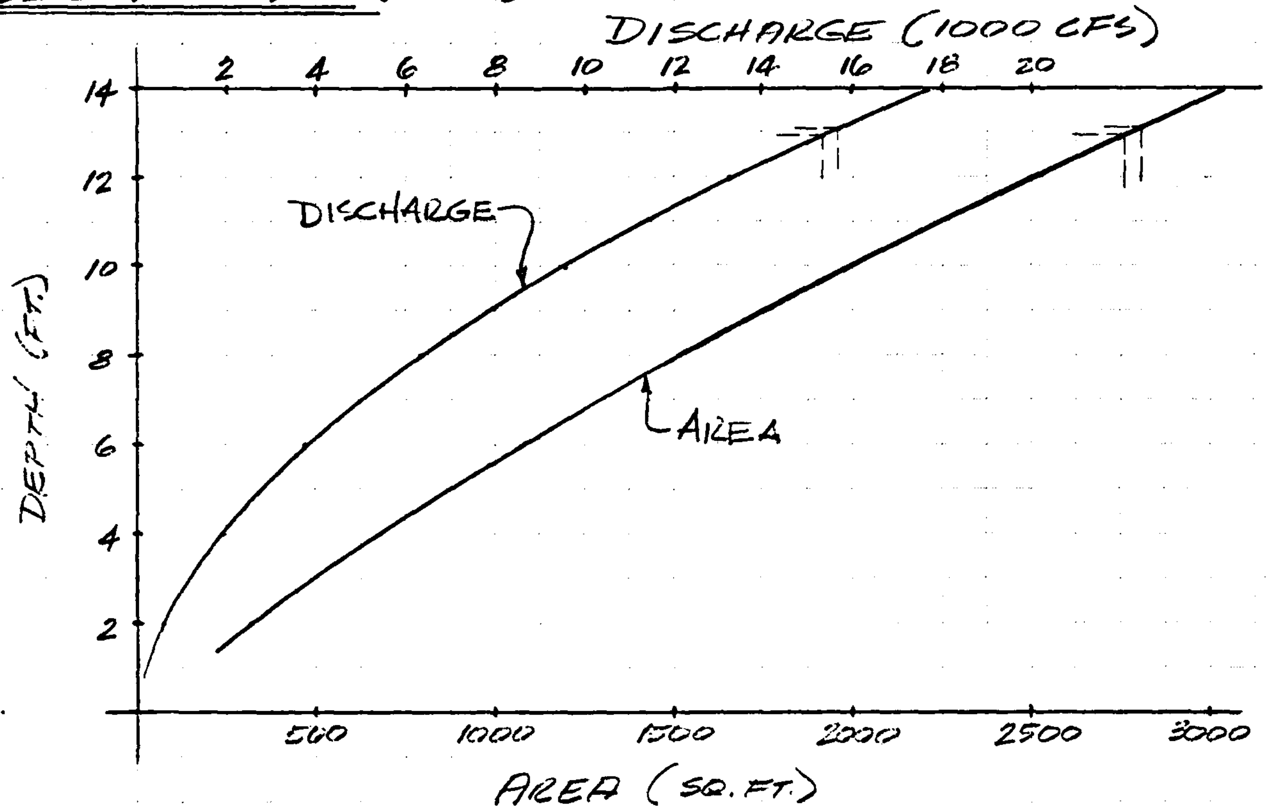
JOB Mashapaug Pond Dam
SHEET NO. 8 OF 29
CALCULATED BY K.A. DATE 2/26/81
CHECKED BY M.R. DATE 3/6/81
SCALE

Section 2 (Cont.)



$Q_{P2} = 15{,}711$ cfs
$H = 13.1$ ft.
$A = 2800$ sq. ft.
$V_1 = 103$ ac. ft.

Q_{P3} (TRIAL) $= 15{,}317$ cfs
$H = 12.9$ ft.
$A = 2760$ sq. ft.
$V_2 = 101$ ac. ft.

$Q_{P3} = 15{,}321$ cfs
$H = 12.9$ ft.

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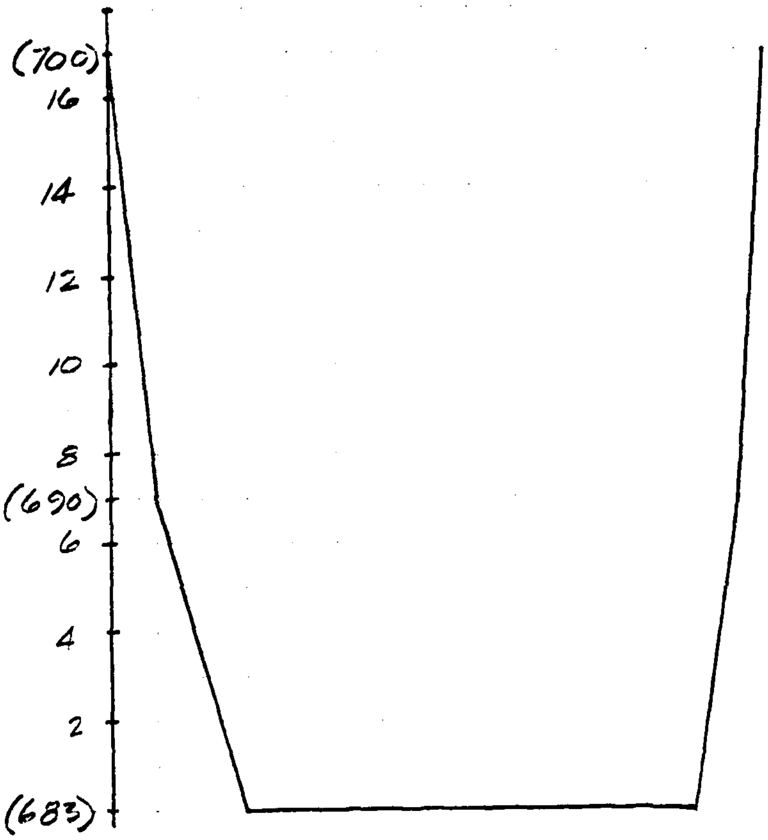
JOB MASHAPAUG POND DAM
SHEET NO. 9 OF 29
CALCULATED BY K.A. DATE 2/27/81
CHECKED BY M.R DATE 3/4/81
SCALE

SECTION 3

STATION 63+00



SCALE:
HOR. 1" = 200'
VER. 1" = 4'

H	A	WP	R	n	V	Q (cfs)
2	1044	544	1.9	.04	1.8	1879
4	2174	586	3.7	.04	2.8	6057
6	3390	630	5.4	.04	3.6	12,204
8	4684	658	7.1	.04	4.4	20,610
10	6012	670	9.0	.04	5.1	30,661

S = .001 ft./ft.
L = 2000 ft.

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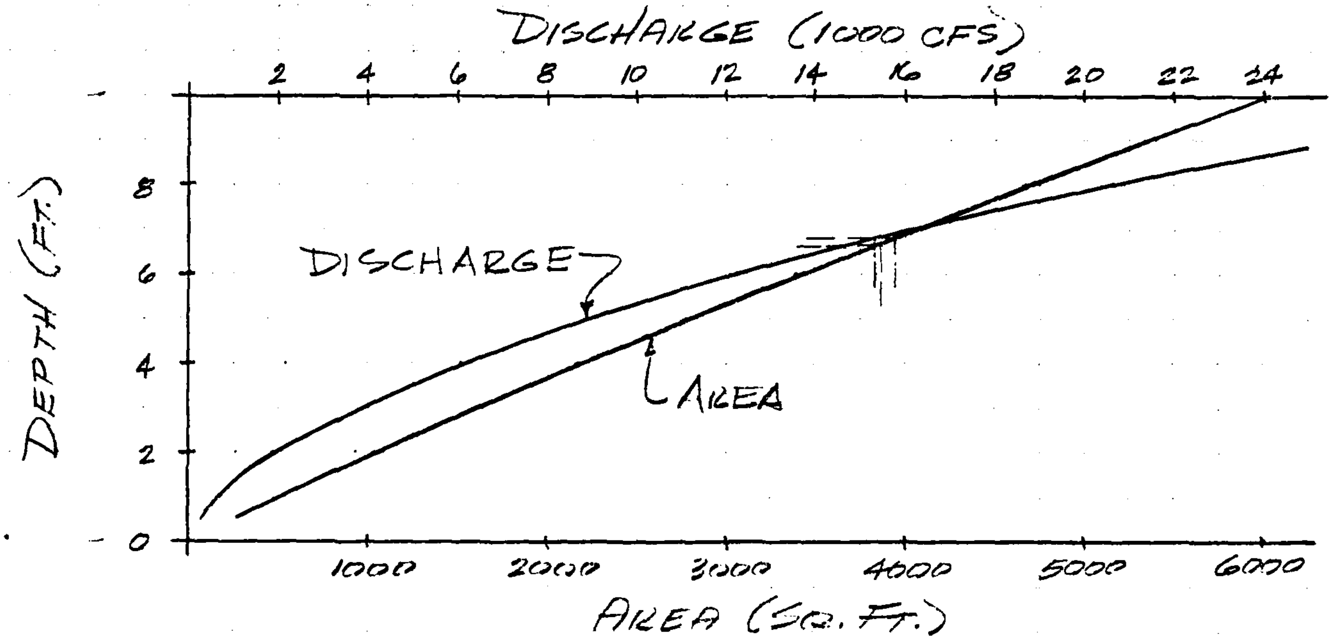
SECTION 3 (CONT.)



Q_{P_3} = 15,321 cfs Q_{P_4} (TRIAL) = 14,646 cfs

H = 6.8 ft. H = 6.6 ft.

A = 3950 sq. ft. A = 3860 sq. ft.

V_1 = 181 ac. ft. V_2 = 177 ac. ft.

Q_{P_4} = 14,653 cfs

H = 6.6 ft.

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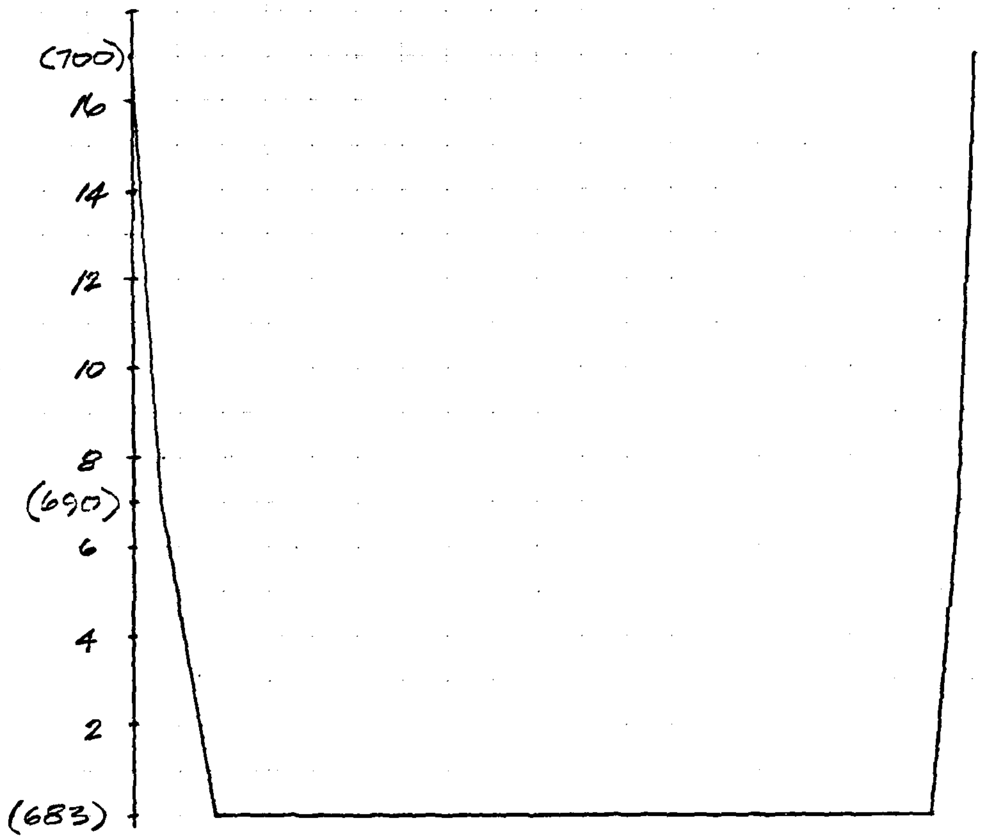
JOB MASHAPAUG POND DAM
SHEET NO. 11 OF 29
CALCULATED BY K. A. DATE 2/27/81
CHECKED BY M.R. DATE 3/6/81
SCALE

SECTION 4

STATION 88+00



SCALE:
HOR. 1" = 200'
VER. 1" = 4'

H	A	WP	R	n	V	Q(cfs)
2	1626	826	2.0	.035	2.1	3415
4	3304	852	3.9	.035	3.3	10,903
6	5034	878	5.7	.035	4.3	21,646
8	6812	898	7.6	.035	5.2	35,422

S = .001 ft./ft.
L = 2500 ft.

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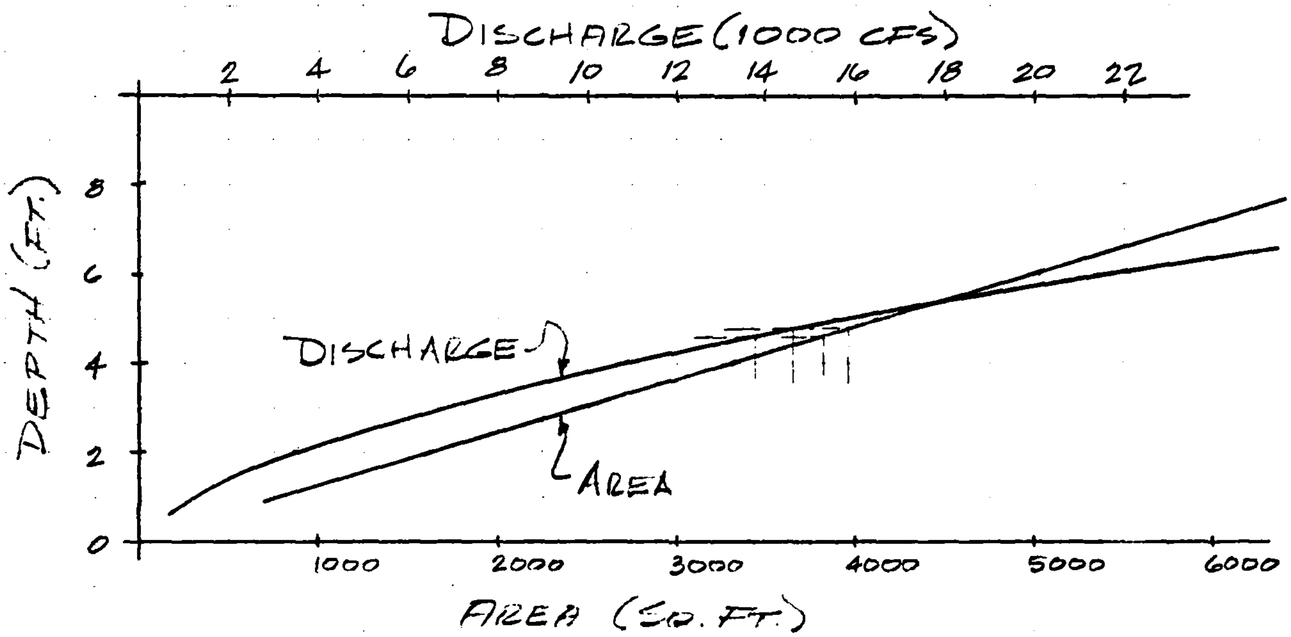
JOB MASHAPAUG POND DAM
SHEET NO. 12 OF 29
CALCULATED BY K. A. DATE 2/27/81
CHECKED BY M.R. DATE 3/6/81
SCALE

SECTION 4 (CONT.)



$Q_{P4} = 14{,}653$ cfs

$H = 4.8$ ft.

$A = 3970$ sq. ft.

$V_1 = 228$ ac. ft.

Q_{P5} (TRIAL) $= 13{,}839$ cfs

$H = 4.6$ ft.

$A = 3820$ sq ft.

$V_2 = 219$ ac. ft.

$Q_{P5} = 13{,}855$ cfs

$H = 4.6$ ft.

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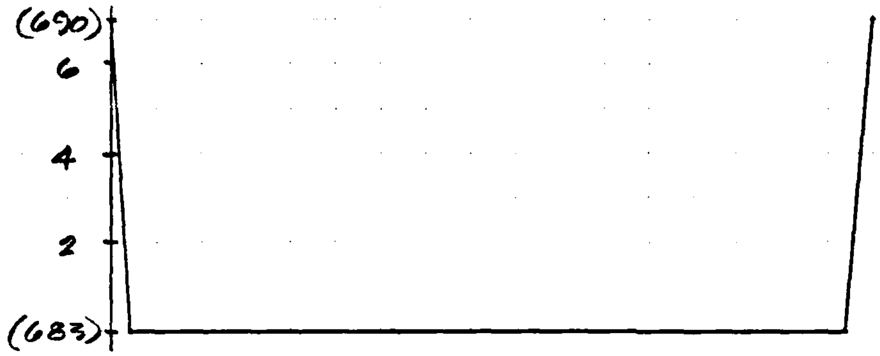
JOB MASHAPAUG POND DAM
SHEET NO. 13 OF 29
CALCULATED BY K.A. DATE 2/27/81
CHECKED BY MR DATE 3/6/81
SCALE

SECTION 5 STATION 128+00



SCALE:
HOR. 1" = 200'
VER. 1" = 4'

H	A	WP	R	n	V	Q (cfs)
2	1612	812	2.0	.035	2.1	3385
4	3254	830	3.9	.035	3.3	10,738
6	4926	842	5.9	.035	4.4	21,674

S = .001 ft/ft.
L = 4000 ft.

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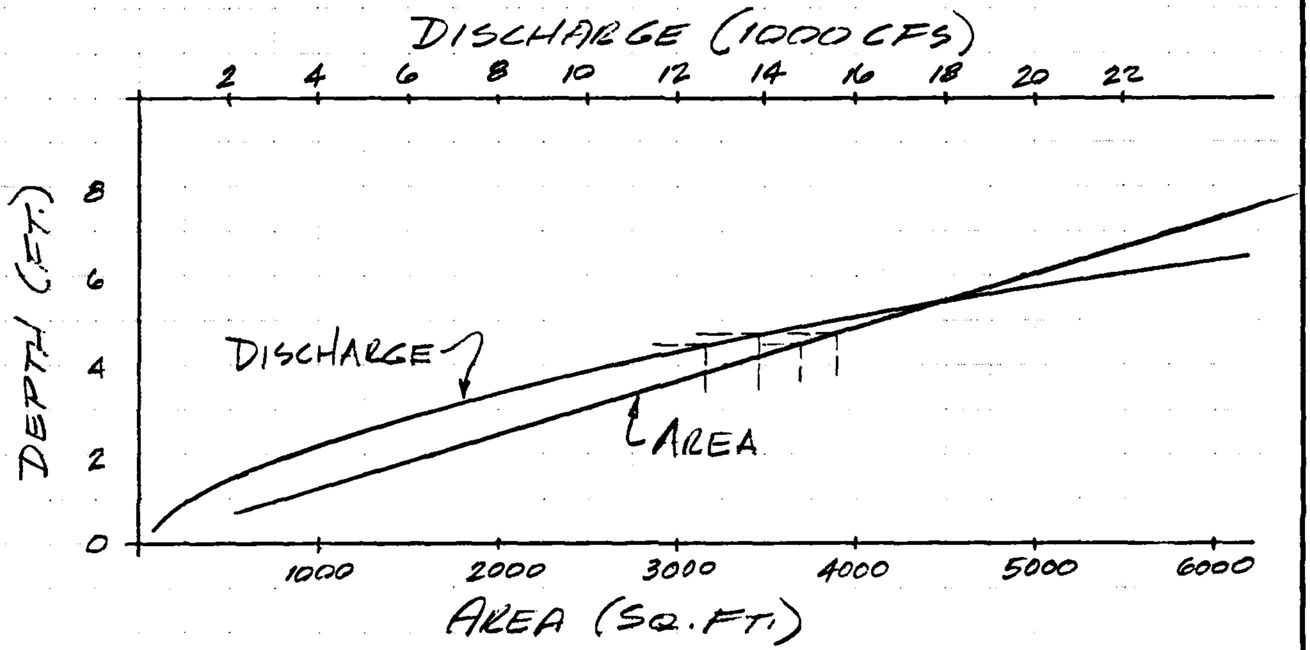
JOB MASHAPAUG POND DAM
SHEET NO. 14 OF 29
CALCULATED BY K. A. DATE 2/27/81
CHECKED BY MR DATE 3/6/81
SCALE

SECTION 5 (CONT.)



$Q_{P5} = 13{,}855$ cfs

$H = 4.7$ ft.

$A = 3900$ sq. ft.

$V_1 = 358$ ac. ft.

Q_{P6} (TRIAL) $= 12{,}647$ cfs

$H = 4.5$ ft.

$A = 3700$ sq. ft.

$V_2 = 340$ ac. ft.

$Q_{P6} = 12{,}677$ cfs

$H = 4.5$ ft.

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1066 Storrs Road
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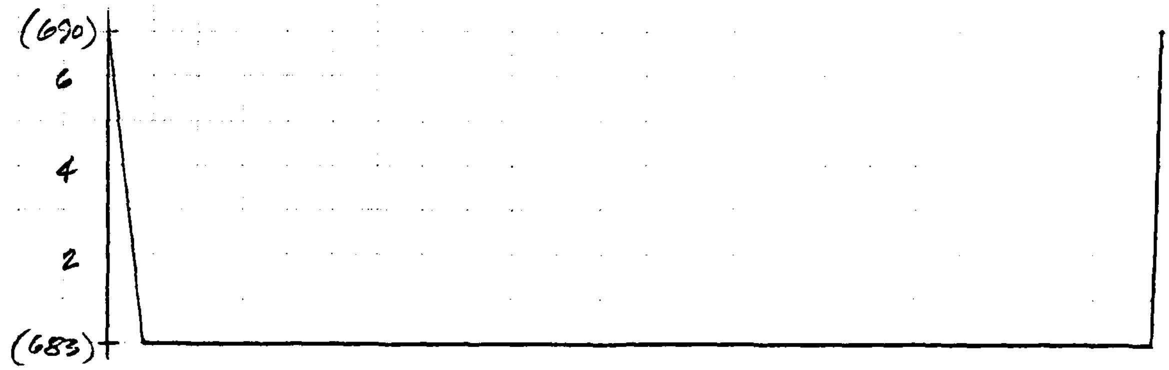
JOB: MASHAPAUG POND DAM
SHEET NO: 15 OF 29
CALCULATED BY: K. A. DATE: 2/27/81
CHECKED BY: M.R. DATE: 3/6/81
SCALE:

SECTION 6 — STATION 144+50



SCALE: HOR. 1" = 400'
VER 1" = 4'

H	A	WP	R	n	V	Q (cfs)
2	4530	2280	2.0	.035	2.1	9513
4	9120	2310	3.9	.035	3.3	30,096
6	13770	2340	5.9	.035	4.4	60,588
3	6825	2300	3.0	.035	2.8	19,110

S = .001 ft/ft
L = 1650 ft.

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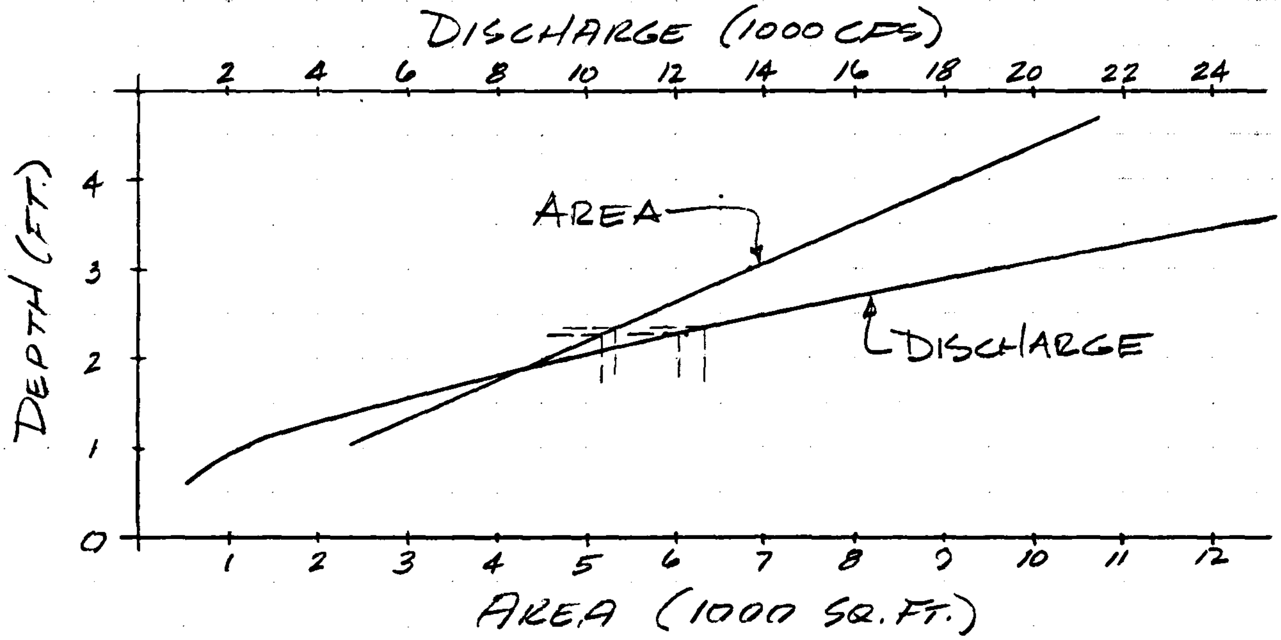
JOB: MASHAPAUG POND DAM
SHEET NO. 16 OF 29
CALCULATED BY: K. A. DATE: 2/27/81
CHECKED BY: M.R. DATE: 3/6/81
SCALE:

SECTION 6 (CONT.)



$Q_{P6} = 12{,}677$ cfs

$H = 2.3$ ft.

$A = 5300$ sq. ft.

$V_1 = 201$ ac. ft.

Q_{P7} (TRIAL) $= 12{,}056$ cfs

$H = 2.3$ ft

$A = 5200$ sq. ft.

$V_2 = 197$ ac. ft.

$Q_{P7} = 12{,}062$ c/s

$H = 2.3$ ft.

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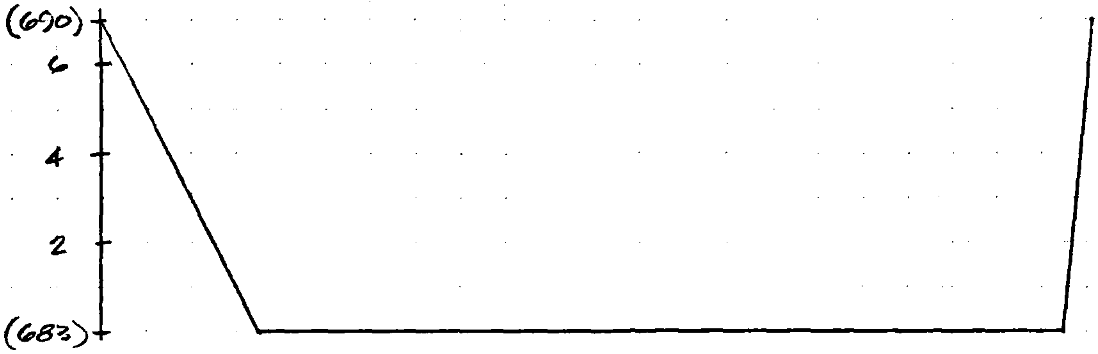
JOB MASHAPAUG POND DAM
SHEET NO. 17 OF 29
CALCULATED BY K. A. DATE 2/27/81
CHECKED BY MR. DATE 3/6/81
SCALE

SECTION 7 STATION 154+50



SCALE: HOR. 1" = 400'
VER. 1" = 4'

H	A	WP	R	n	V	Q(cfs)
2	3720	1920	1.9	.035	2.1	7812
4	7680	2040	3.8	.035	3.3	25,344
6	11870	2150	5.5	.035	4.2	49,854
3	5670	1980	2.9	.035	2.7	15,309

S = .001 ft./ft.
L = 1000 ft.

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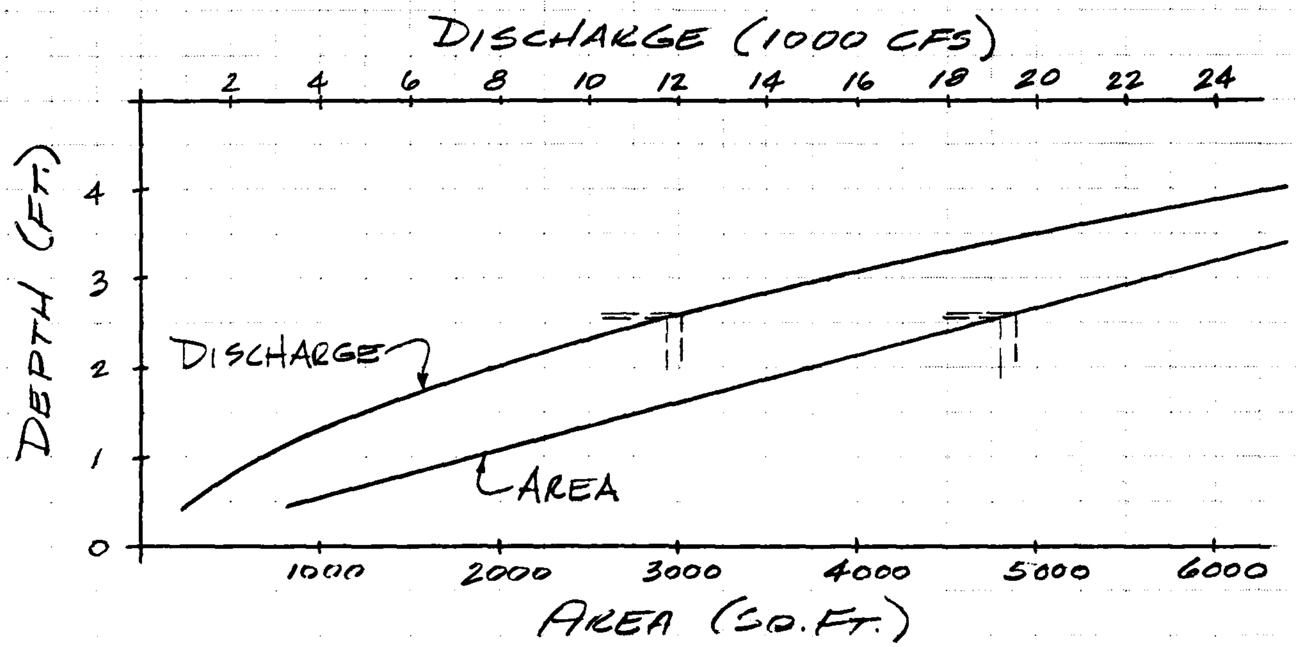
JOB MASHAPAUG POND DAM
SHEET NO. 18 OF 29
CALCULATED BY K. A. DATE 2/27/81
CHECKED BY M.R. DATE 3/6/81
SCALE

SECTION 7 (CONT.)



Q_{P7} = 12,062 cfs
H = 2.6 ft.
A = 4900 sq. ft.
V_1 = 112 ac. ft.

Q_{P8} (TRIAL) = 11,733 cfs
H = 2.6 ft
A = 4800 sq. ft.
V_2 = 110 ac. ft.

Q_{P8} = 11,736 cfs
H = 2.6 ft.

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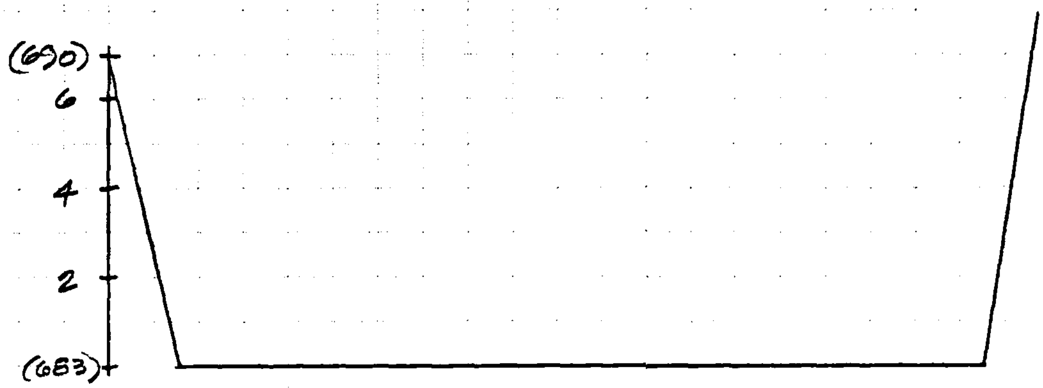
SECTION 8 STATION 184+50



SCALE: HOR. 1" = 200'
VER. 1" = 4'

H	A	WP	R	n	V	Q(cfs)
2	1836	936	2.0	.04	1.9	3488
3	2781	954	2.9	.04	2.4	6674
4	3749	982	3.8	.04	2.9	10,872
6	5741	1010	5.7	.04	3.8	21,816

S = .001 ft./ft.
L = 3000 ft.

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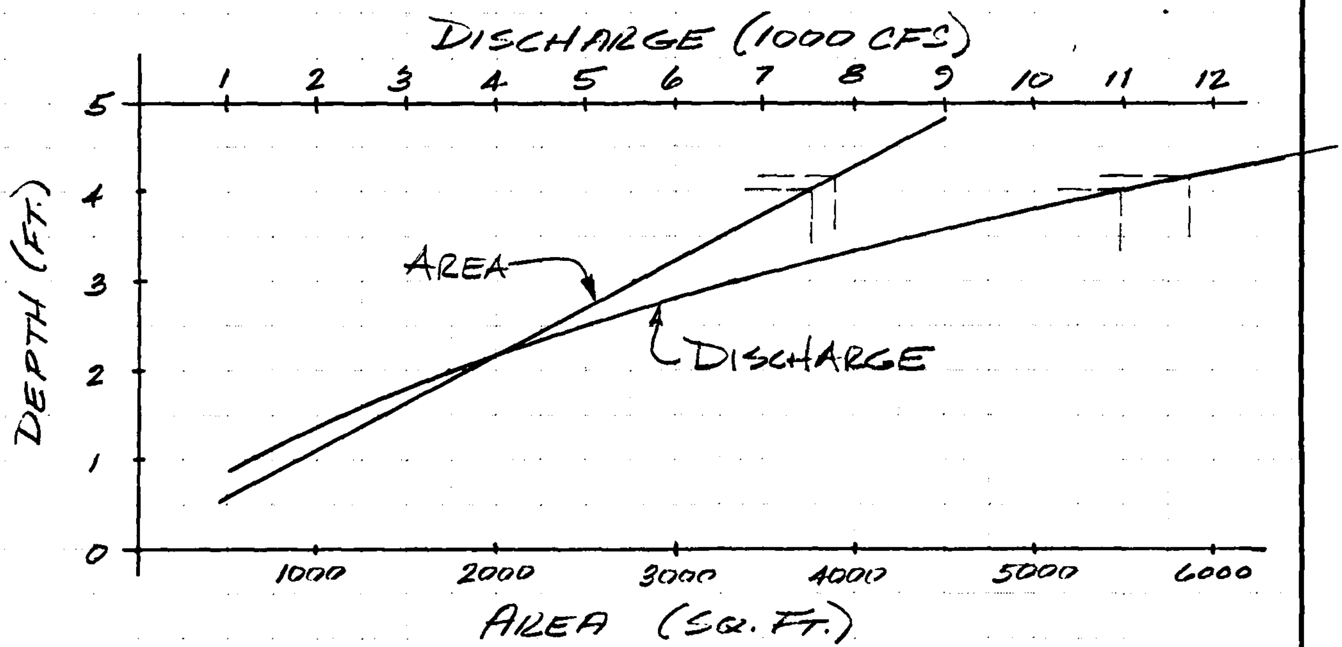
JOB MASHAPAUG POND DAM
SHEET NO. 20 OF 29
CALCULATED BY K.A. DATE 3/2/81
CHECKED BY MR DATE 3/6/81
SCALE

SECTION 8 (CONT.)



Q_{P8} = 11,736 cfs
H = 4.2 ft.
A = 3900 sq. ft.
V_1 = 269 ac. ft.

Q_{P9} (TRIAL) = 10,967 cfs
H = 4.0 ft.
A = 3760 sq. ft.
V_2 = 259 ac. ft.

Q_{P9} = 10,981 cfs
H = 4.0 ft.

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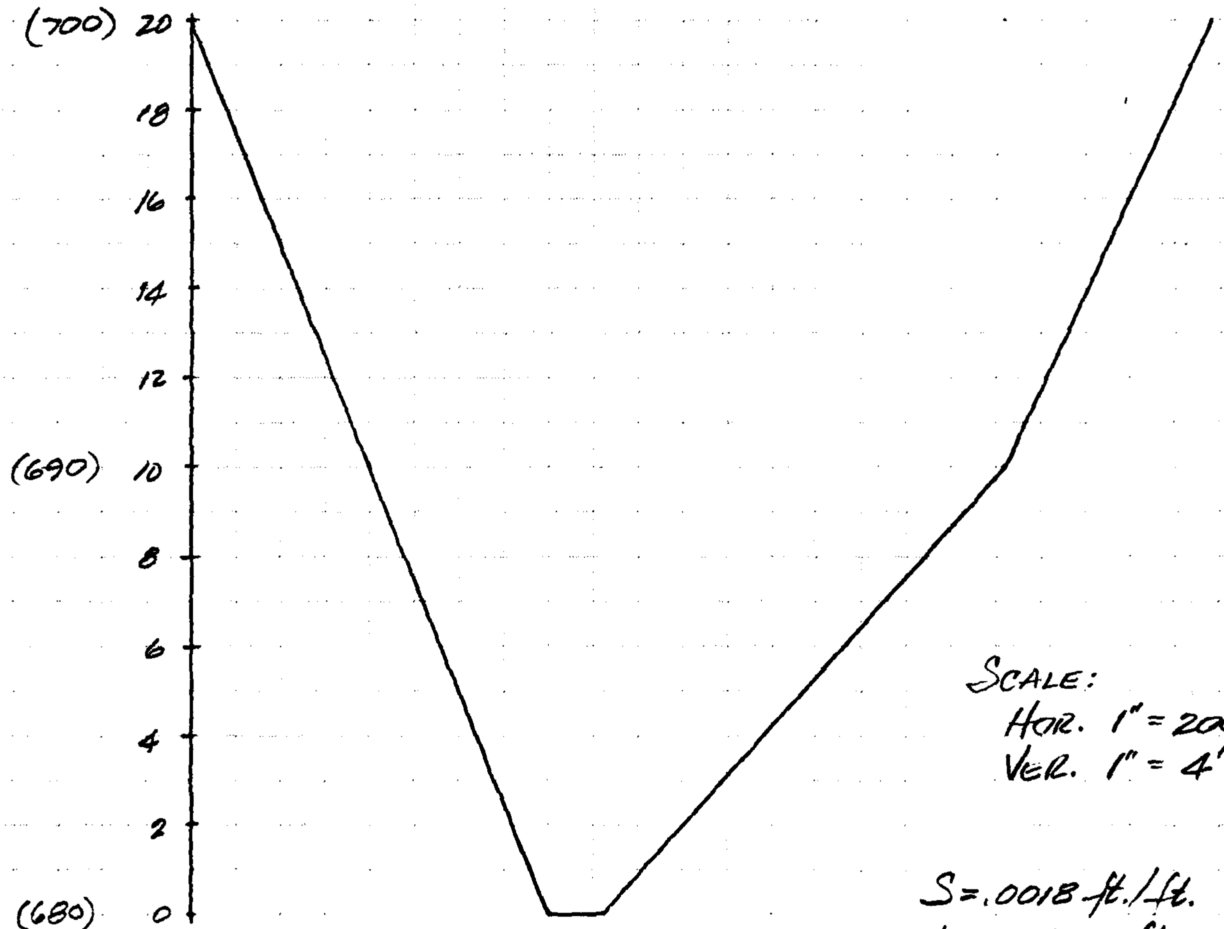
JOB MASHAPAUG POND DAM
SHEET NO 21 OF 29
CALCULATED BY K.A. DATE 3/2/81
CHECKED BY M.R. DATE 3/6/81
SCALE

SECTION 9

STATION 201+50



SCALE:
HOR. 1" = 200'
VER. 1" = 4'

S = .0018 ft./ft.
L = 1700 ft.

H	A	WP	R	n	V	Q (cfs)
2	250	190	1.3	.04	1.9	475
4	760	320	2.4	.04	2.8	2128
6	1530	450	3.4	.04	3.6	5508
8	2560	580	4.4	.04	4.2	10,752
10	3850	710	5.4	.04	4.9	18,865

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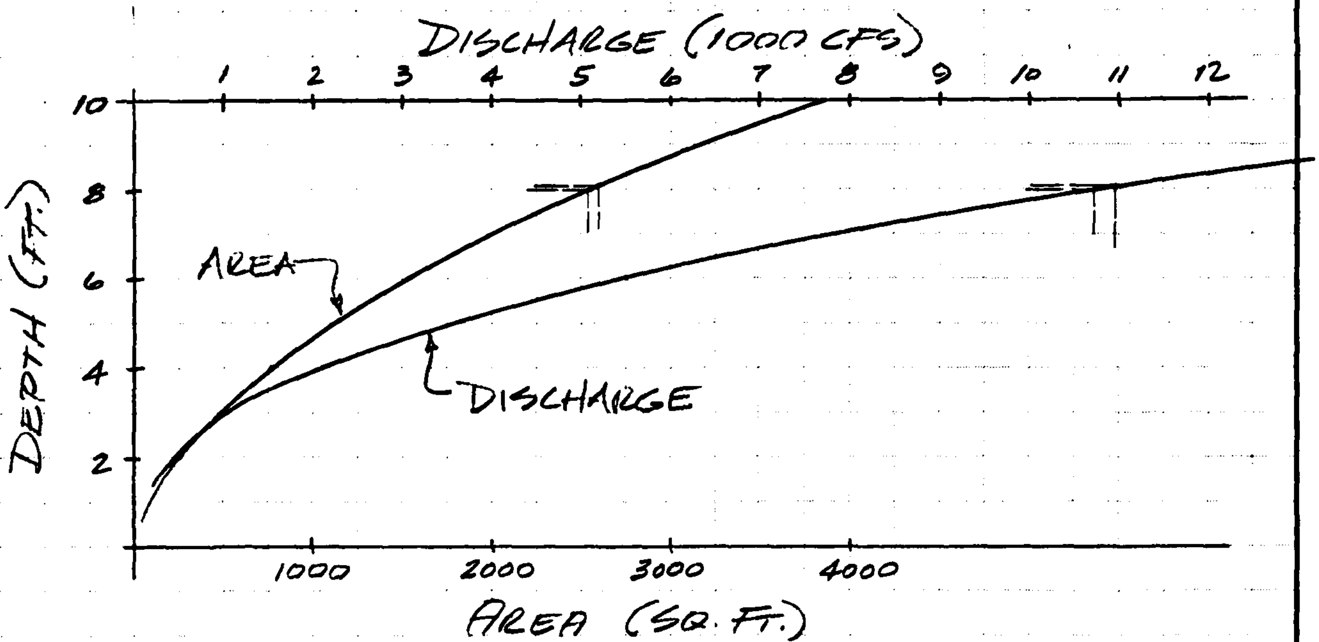
SECTION 9 (CONT.)



Q_{P9} = 10,981 cfs

H = 8.1 ft.

A = 2600 sq. ft.

V_1 = 101 ac. ft.

Q_{P10} (TRIAL) = 10,711 cfs

H = 8.0 ft.

A = 2550 sq. ft.

V_2 = 100 ac. ft.

Q_{P10} = 10,712 cfs

H = 8.0 ft.

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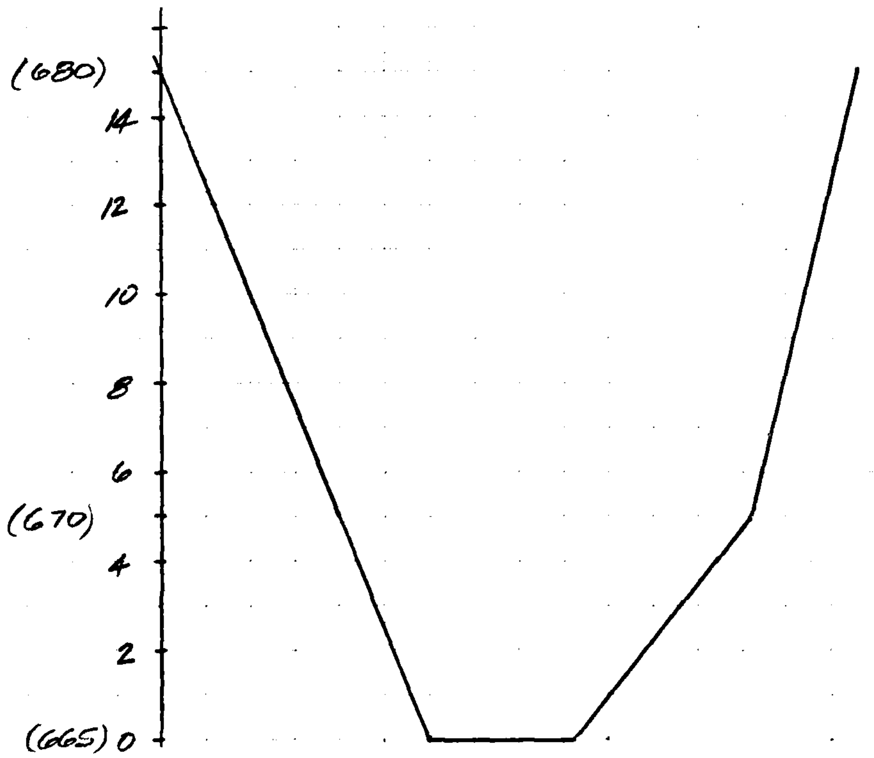
JOB MASHAPAUG POND DAM
SHEET NO 23 OF 29
CALCULATED BY K.A. DATE 3/2/81
CHECKED BY MR DATE 3/6/81
SCALE

SECTION 10 — STATION 216+50



SCALE:
HOR. 1" = 100'
VER. 1" = 4'

H	A	WP	R	n	V	Q (cfs)
2	220	140	1.6	.05	4.1	902
4	560	200	2.8	.05	5.9	3304
6	1013	246	4.1	.06	6.4	6483
8	1539	280	5.5	.06	7.7	11,850
10	2129	310	6.9	.07	7.7	16,393
12	2779	340	8.2	.07	8.7	24,177

S = .01 ft/ft
L = 1500 ft

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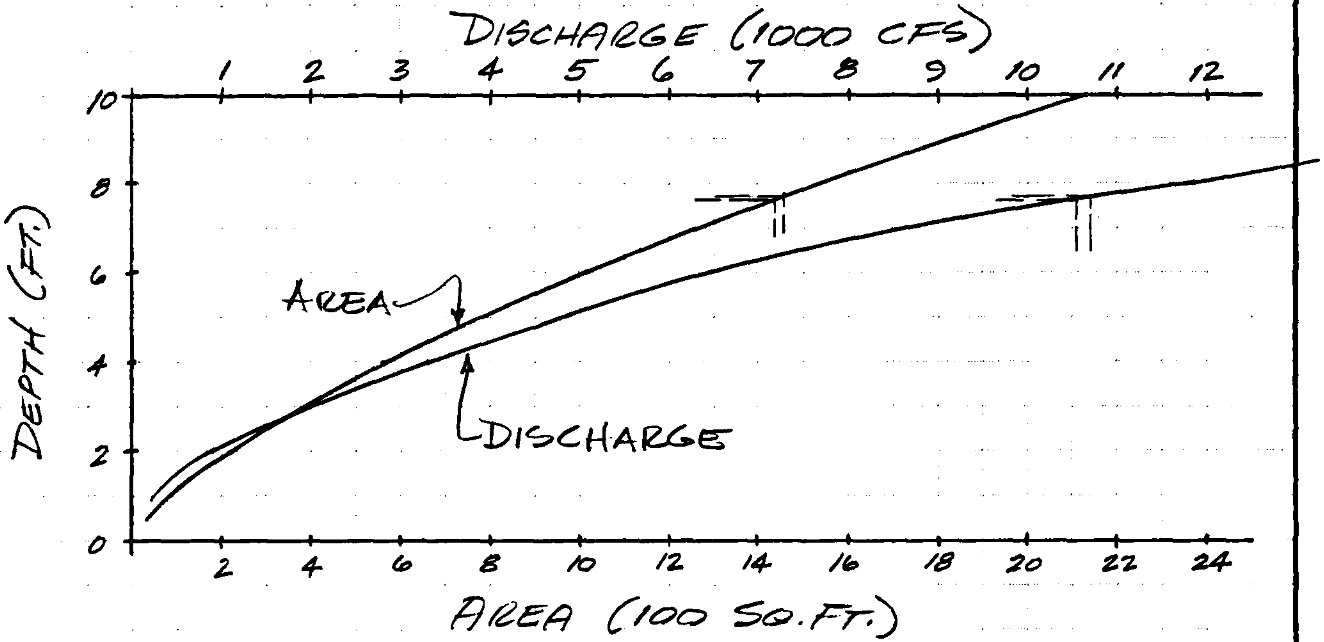
JOB Mashapaug Pond Dam
SHEET NO. 24 OF 29
CALCULATED BY K. A. DATE 3/2/81
CHECKED BY MR DATE 3/6/81
SCALE

Section 10 (cont.)



$Q_{P10} = 10{,}712$ cfs

$H = 7.7$ ft.

$A = 1460$ sq. ft.

$V_1 = 50$ ac. ft.

Q_{P11} (TRIAL) $= 10{,}582$ cfs

$H = 7.6$ ft.

$A = 1440$ sq. ft.

$V_2 = 50$ ac. ft.

$Q_{P11} = 10{,}582$ cfs

$H = 7.6$ ft.

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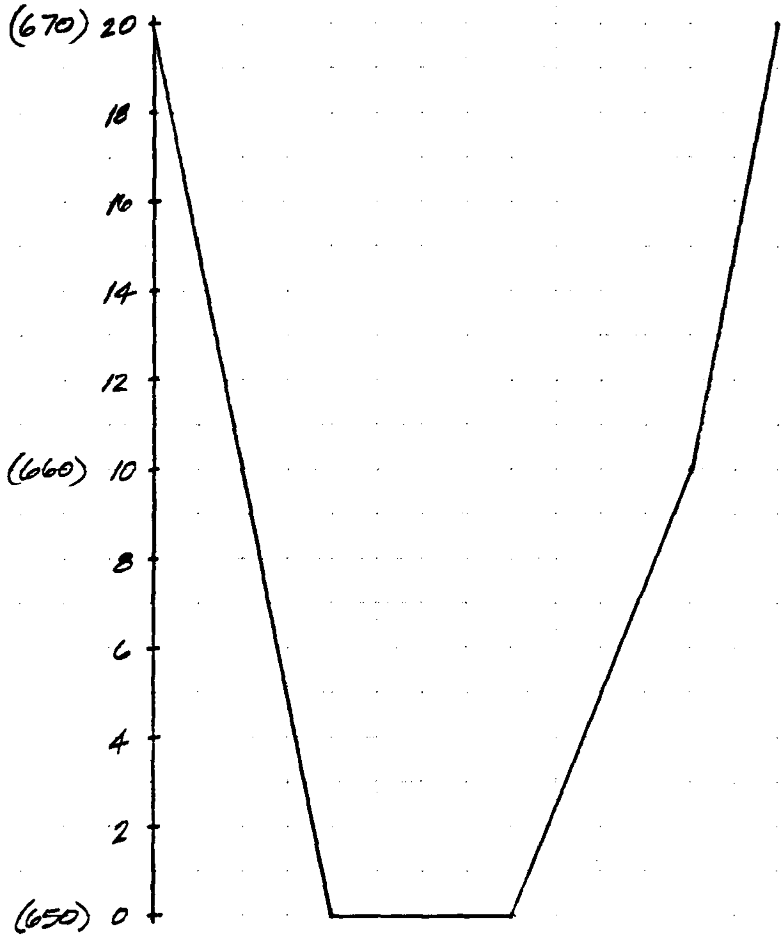
JOB MASHAPAUG POND DAM
SHEET NO 25 OF 29
CALCULATED BY K.A. DATE 3/2/81
CHECKED BY M.R. DATE 3/6/81
SCALE

SECTION 11 STATION 238+50



SCALE:
HOR. 1" = 100'
VER. 1" = 4'

$S = .0068$ ft./ft.
$L = 2200$ ft.

H	A	WP	R	n	V	Q (cfs)
2	230	130	1.8	.05	3.6	828
4	520	160	3.3	.05	5.4	2808
6	870	190	4.6	.06	5.7	4959
8	1280	220	5.8	.06	6.6	8448
10	1750	250	7.0	.07	6.4	11,200
12	2270	270	8.4	.07	7.3	16,571

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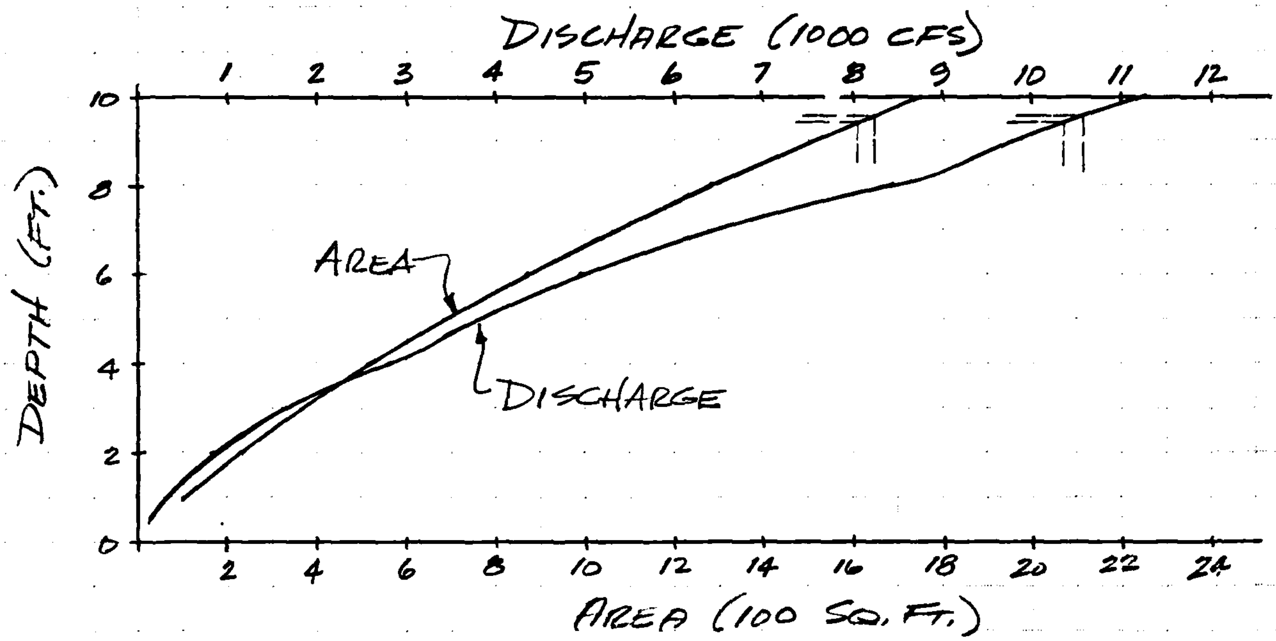
SECTION 11 (CONT.)



$Q_{P11} = 10,582$ cfs

$H = 9.6$ ft.

$A = 1645$ sq. ft.

$V_1 = 83$ ac. ft.

Q_{P12} (TRIAL) $= 10,368$ cfs

$H = 9.4$ ft.

$A = 1610$ sq. ft

$V_2 = 81$ ac. ft.

$Q_{P12} = 10,371$ cfs

$H = 9.4$ ft.

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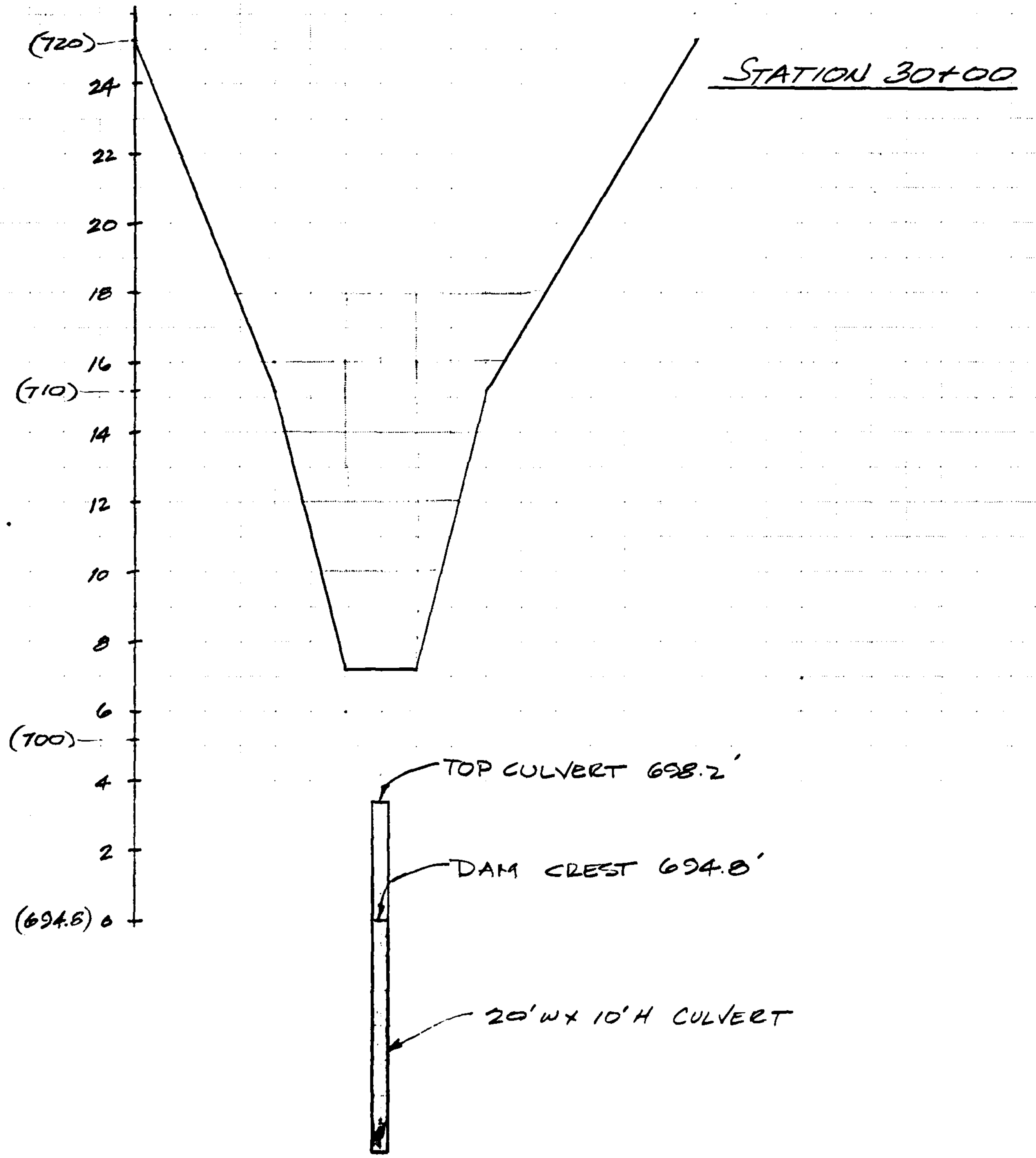
JOB MASHAPAUG POND DAM

CALCULATED BY K. A. DATE 3/2/81
CHECKED BY MR DATE 3/6/81
SCALE HOR. 1" = 200', VERT. 1" = 4'

SECTION 1-A DISCHARGE AT I-86

STATION 30+00



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SECTION 1-A (CONT.)

CULVERT FLOW: INLET(1) & OUTLET(2) CONTROL NOMOGRAPHS

ROAD FLOW: $Q = CLH^{1.5}$ (Slope $Q = CL(H/2)^{1.5} + H^2$)

H	$Q_{CULVERT}$	Q_{ROAD}	Q_{TOTAL} (cfs)
2	178 (1)	—	178
4	460 (1)	—	460
6	680 (1)	—	680
8	900 (1)	193	1093
10	1050 (2)	1477	2527
12	1200 (2)	3809	5009
14	1340 (2)	7284	8624
15.2	1400 (2)	9785	11,185
16	1450 (2)	12,357	13,807
18	1550 (2)	15,939	17,489

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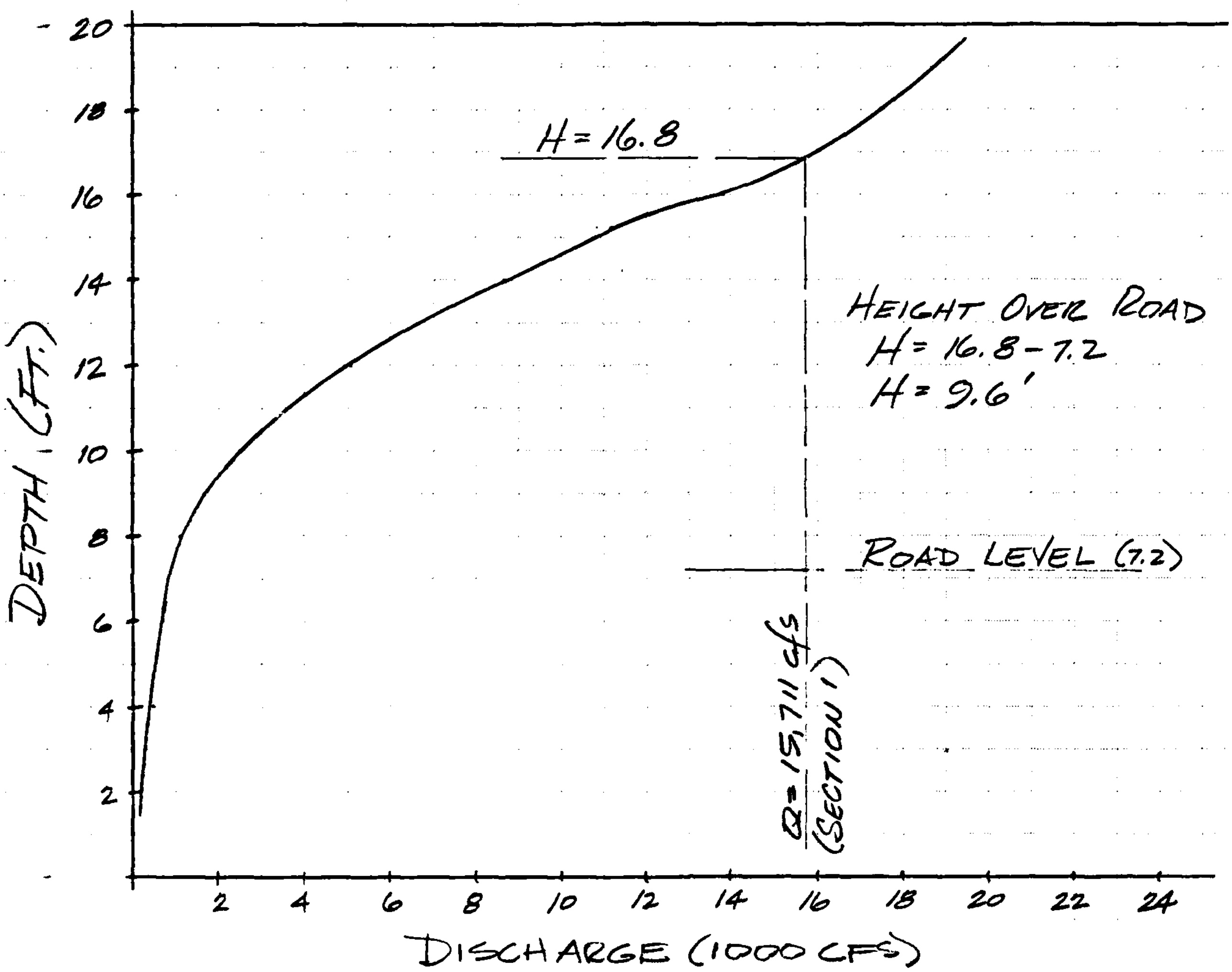
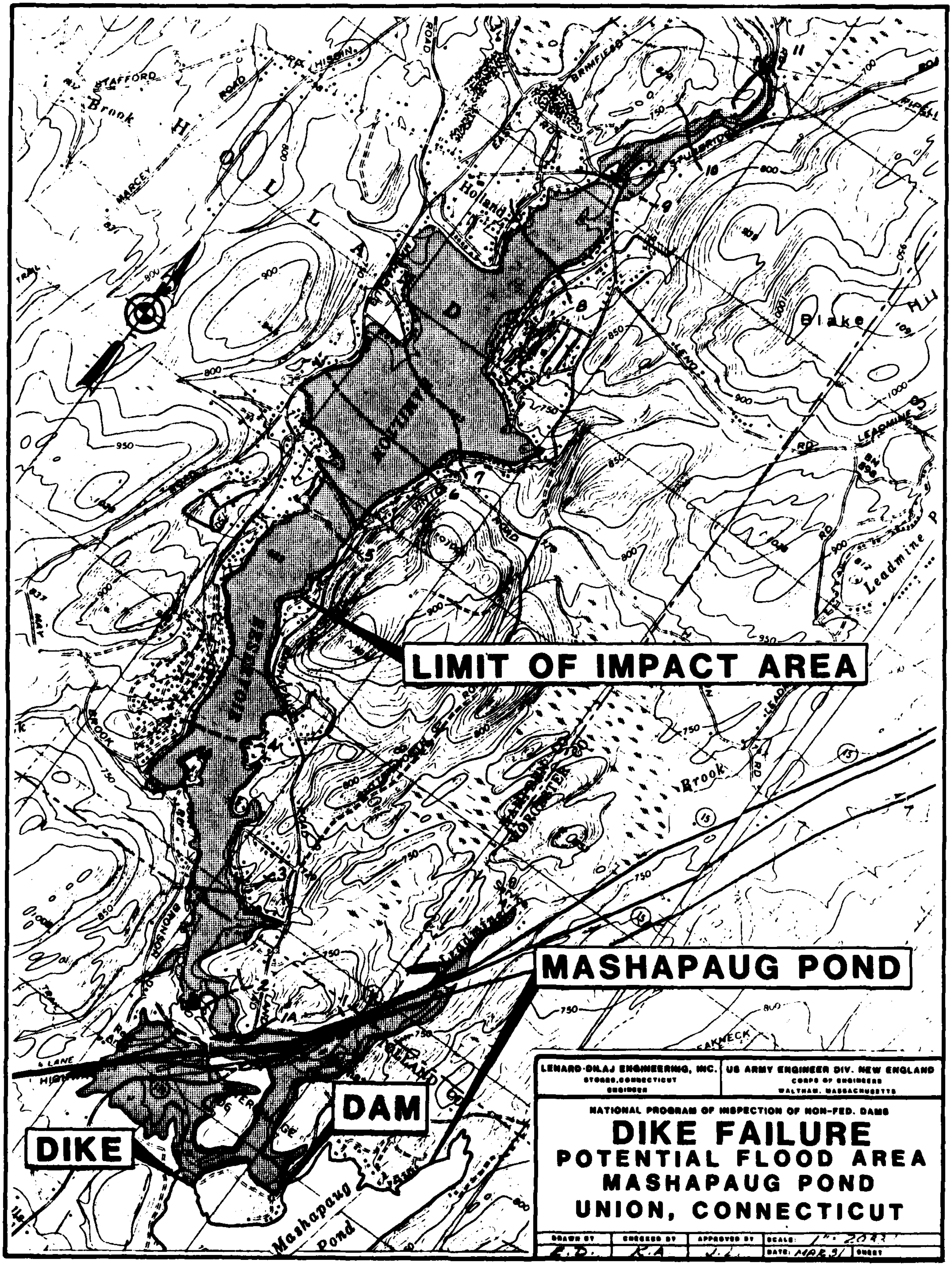
JOB MASHAPAUG POND DAM
SHEET NO. 29 OF 29
CALCULATED BY K.A. DATE 3/2/81
CHECKED BY MR. DATE 3/6/81
SCALE

SECTION 1-A (CONT.)




LIMIT OF IMPACT AREA
MASHAPAUG POND
DAM
DIKE
Holland
Blake Hill
Leadmine P
Brook
Mashapaug Pond
LENARD-DILAJ ENGINEERING, INC.
STORRS, CONNECTICUT
ENGINEER
US ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
DIKE FAILURE
POTENTIAL FLOOD AREA
MASHAPAUG POND
UNION, CONNECTICUT
DRAWN BY R.D.
CHECKED BY R.A.
APPROVED BY
SCALE: 1" = 2083'
DATE: MAR.91
SHEET

APPENDIX E

INFORMATION AS CONTAINED IN THE

NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR. DIST.	STATE	COUNTY	CONGR. DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
CT	6[illegible]	NED	CT	013	02				MASHAPAUG POND SPILLWAY	4200.3	7207.8	02DEC80

POPULAR NAME	NAME OF IMPOUNDMENT
	MASHAPAUG POND

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	10	BIGELOW BROOK	UNION	1	540

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)
PG	1900	R	12	10	5860	5290

DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
NED	N	N	N	N	

REMARKS
9-SEE ALSO CT01699 DIKE AND CT01700 DAM ON MASHAPAUG POND

D/S HAS	SPILLWAY LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NO	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
3	60	U	25	200	90											

NAVIGATION LOCKS: columns NO through last WIDTH.

OWNER	ENGINEERING BY	CONSTRUCTION BY
AMERICAN OPTICAL CO	UNKNOWN	UNKNOWN

REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	CT DEP	CT DEP

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
LENARD < DILAJ ENGINEERING INC	02DEC80	PL 92-367

REMARKS
32-60FT INCL ABUTMENTS 33-815CFS OVER ABUTMENTS TO TOP DAM

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR. DIST.	STATE	COUNTY	CONGR. DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
CT	169	NED	CT	01	02				MASHAPAUG POND DIKE	4201.4	7208.4	02DEC80

POPULAR NAME	NAME OF IMPOUNDMENT
	MASHAPAUG POND

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	10	QUINEBAUG RIVER	UNION	1	540

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
REPG	1900	R	18	15	6725	5290	NED	N	N	N	N	

REMARKS
9-SEE ALSO CT01700 DAM AND CT00640 SPILLWAY

D/S HAS	SPILLWAY LENGTH (FT.)	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO.	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
1	50				15200											

OWNER	ENGINEERING BY	CONSTRUCTION BY
AMERICAN OPTICAL CO	UNKNOWN	UNKNOWN

REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	CT DEP	CT DEP

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
LENARD & DILAJ ENGINEERING INC	02DEC80	PL 92-367

REMARKS
31-NO SPILLWAY OR OUTLET WORKS AT THIS SITE

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR. DIST.	STATE	COUNTY	CONGR. DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
CT	1700	NED	CT	013	02				MASHAPAUG POND DAM	4201.3	7208.1	02DEC80

POPULAR NAME	NAME OF IMPOUNDMENT
	MASHAPAUG POND

REGION	BASN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	10	QUINEBAUG RIVER	UNION	1	540

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
REEG	1900	R	18	15	6725	5290	NED	N	N	N	N	

REMARKS
9-SEE ALSO CT00640 SPILLWAY AND CT01699 DIKE

D/S HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
1	290	N			6500											

OWNER	ENGINEERING BY	CONSTRUCTION BY
AMERICAN OPTICAL CO	UNKNOWN	UNKNOWN

REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	CT DEP	CT DEP

INSPECTION BY	INSPECT ON DATE DAY MO YR	AUTHORITY FOR INSPECTION
LENARD & DILAJ ENGINEERING INC	02DEC80	PL 92-367

REMARKS
51-NO SPILLWAY AT THIS SITE

END

FILMED

9-84

DTIC